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DEPARTMENT OF THE ARMY
Washington, DC, 22 April 1993

HEALTH SERVICE SUPPORT IN A NUCLEAR, BIOLOGICAL, AND CHEMICAL ENVIRONMENT

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CHANGE 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 26 November 1996

HEALTH SERVICE SUPPORT IN A NUCLEAR, BIOLOGICAL, AND CHEMICAL ENVIRONMENT

1. FM 8-10-7, 22 April 1993, is changed as follows:
2. New or changed material is indicated by a star (★).
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PREFACE

Purpose and Scope

The purpose of this manual is to provide doctrine and tactics, techniques, and procedures for medical units and personnel operating in a nuclear, biological, and chemical (NBC) environment. This manual is intended for all echelons of health service support (HSS). It discusses the operational aspects of the following HSS activities: Medical treatment, medical evacuation, health service logistics, combat stress control, and preventive medicine, veterinary, dental, and medical laboratory services.

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Standardization Agreements

This manual implements North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) 2866, Medical Effects of Ionizing Radiation. It is also in consonance with the following NATO STANAGs and Quadripartite Standardization Agreements (QSTAGs):

TITLE	NATO STANAG	QSTAG
Warning Signs for the Marking of Contaminated or Dangerous Land Areas, Complete Equipments Supplied and Stores		2002
Emergency War Surgery	2068	322
Commander's Guide on Nuclear Radiation Exposure of Groups	2083	
Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas	2103	
Friendly Nuclear Strike Warning	2104	
Radiological Survey	2112	
Friendly Chemical Attack Warning	2398	

Dosimetry and Dosimetry Readings	2423	
Concept of Operations of Medical Support in Nuclear, Biological, and Chemical Environment (AMedP-7)	2873	
Principles of Medical Policy in the Management of a Mass Casualty Situation	2879	816
Training of Medical Personnel for NBC Operations	2954	

Gender Statement

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

CHAPTER 1

MEDICAL THREAT AND NUCLEAR, BIOLOGICAL, AND CHEMICAL WARFARE

1-1. General

a. Since World War II, the Soviet Union has represented the principal threat to the national security interests of the US. During this period, the military capability of the Soviet Armed Forces grew enormously. Starting in the later years of the 1980's, the international security environment has undergone rapid, fundamental, and revolutionary changes. The Soviet Union has disintegrated with the collapse of Soviet communism as a viable economic and political system. The Warsaw Pact has dissolved as a political and military entity. The central Soviet government has been replaced by the Commonwealth of Independent Republics (CIR), currently dominated by the Russian Republic. The cohesion of Soviet strategic military capability has been fractured by—

- The dissolution of central Soviet control.
- The formation of the CIR.
- The unpredictability associated with uncertain loyalties and low morale.

The ultimate outcome of these events in terms of US national security interests is unclear. The military capabilities of independent republics like Russia, Ukrainia, Kazakhstan, and Byelorus remain formidable. The capabilities include strategic nuclear and impressive conventional, biological, and chemical warfighting capabilities.

b. From a global perspective, the economic power and influence of developing and newly industrialized nations will continue to grow. Centers of power (global or regional) cannot be measured solely in military terms. Nation states will pursue their own political, ideological, and economic interests; they may become engaged in director indirect competition and conflict with the US. More nations have acquired significant numbers of modern, lethal, combat weapon systems; developed very capable armed forces; and become more assertive in international tiairs. In the absence of a single, credible, coercive threat, old rivalries and long repressed territorial ambitions will resurface, causing increased tensions in many regions. Political, economic, and social instability and religious, cultural, and economic competition will continue to erode the influence of the US over the rest of the world. This erosion will also reduce the US influence of traditional regional powers over their neighbors. This environment will encourage the continued development, or acquisition, of modern armed forces and equipment by less influential nations, including the spread of NBC weapons; thus raising the potential for internal conflict and armed confrontations in developing regions of the world.

1-2. Medical Threat

a. Medical threat is the composite of all ongoing or potential enemy actions and environmental conditions that will reduce combat effectiveness through wounding, injuring, causing disease, and/or degrading performance. Soldiers are the targets of these threats. Weapons or environmental conditions that will generate wounded, injured, and sick soldiers, beyond the capability of the HSS system to provide timely medical care from available resources, are considered major medical threats. Weapons or environmental conditions that produce qualitatively different wound or disease processes are also major medical threats. Table 1-1 presents medical threats from both environmental and adversary sources. Elements of medical threat are used to define the vulnerability of and the risk to the soldier associated with deployment outside the US.

Table 1-1. Medical Threat from Environmental and Adversary Sources

ENVIRONMENTAL RELATED	ADVERSARY RELATED
Naturally occurring diseases	Small arms and fragmentation ordnance and munitions
Environmental extremes	Biological warfare
Hazardous plants and animals	Chemical warfare
Other environmental hazards (dust, water, and air pollution)	Flame and incendiary
	Blast effect munitions
	Directed energy devices
	Nuclear warfare
Sustained operations/combat stress*	

*Applicable to both environmental and adversary related conditions.

b. Enemy combat operations that disrupt HSS operations, or threaten the HSS organizations survival are considered threats to the medical mission. These threats, however, are not considered to be "medical threats".

1-3. Nuclear, Biological, and Chemical Threat—The Health Services Perspective

a. Nuclear Weapons Threat. Since the breakup of the Soviet Union, the number of countries with known nuclear capable military forces has almost doubled. Available information suggests that a number of countries in the Middle East, Asia, and Africa may have nuclear weapons capability within the next decade. Table 1-2 lists those countries known to have, or suspected of possessing, nuclear weapons. Planners can expect a minimum of 10 to 20 percent casualties within a division-sized force that has experienced a nuclear strike. In addition to casualties, a nuclear weapon detonation can generate an electromagnetic pulse (EMP) that will cause catastrophic failures of electronic equipment components.

Table 1-2. Countries Having or Seeking Nuclear Weapons

KNOWN TO POSSESS	SUSPECT OR SEEKING
United States of America	Iraq
Russia	North Korea
Ukraine	Pakistan
Byelorus	India
Kazakhstan	Iran
People's Republic of China	Libya
France	Algeria
United Kingdom	South Africa
	Israel

b. Biological Warfare.

(1) Biological warfare (BW) is defined by the US intelligence community as the intentional use of disease-causing organisms (pathogens), toxins, or other agents of biological origin (ABO) to incapacitate, injure, or kill humans and animals; to destroy crops; to weaken resistance to attack; and to reduce the will to fight. Historically, BW has primarily involved the use of pathogens as sabotage agents in food and water supplies to spread contagious disease among target populations.

(2) For purposes of medical threat risk assessment, we are interested only in those BW agents that incapacitate, injure, or kill humans or animals.

(3) Known or suspect BW agents and ABOs can generally be categorized as naturally occurring, unmodified infectious agents (pathogens); toxins, venoms, and their biologically active fractions; modified infectious agents; and bioregulators. See Table 1-3 for examples of known or suspected threat BW agents. Also, Table 1-4 presents possible future agents in BW development.

Table 1-3. Examples of Known or Suspect Biological Warfare Agents

PATHOGENS	TOXINS
Bacillus anthracis (Anthrax)	Botulinum toxin
Francisella tularenius (Tularemia)	Mycotoxins
Yersinia pestis (Plague)	Enterotoxin
Brucella species (Brucellosis)	Ricin
Vibrio cholerae (Cholera)	

Table 1-4. The Future of Biological Warfare Agents

CURRENT THREAT	FUTURE
Pathogens	Modified Pathogens
Limited Number of Toxins	Expanded Range of Toxins (Organo-toxins)
	Protein Fractions
	Agents of Biological Origin

(4) Many governments recognize the industrial and economic potential of advanced biotechnology and bioengineering. The same knowledge, skills, and methodologies can be applied to the production of second and third generation BW agents. Naturally occurring infectious organisms can be made more virulent and antibiotic resistant and manipulated to render protective vaccines

ineffective. These developments complicate the ability to detect and identify BW agents and to operate in areas contaminated by the BW agents.

c. Chemical Warfare.

(1) Since World War I, chemical warfare (CW) has been publicly held in disrepute by most western political and military leaders. However, evidence accumulated over the last 50 years does not support the position that public condemnation equates to limiting development, or use of offensive CW agents. The reported use of chemical agents and toxins in Southeast Asia by Vietnamese forces; the confirmed use of CW agents by Egypt against Yemen; and later by Iraq against Iranian forces; and the probable use of CW agents by the Soviets in Afghanistan indicate a heightened interest in CW as a force multiplier. Mso, an offensive CW capability is developed as a deterrent to the military advantage of a potential adversary. Table 1-5 list the most common CW agents. Table 1-6 lists those countries known or suspected of having offensive chemical weapons.

Table 1-5. Common Chemical Warfare Agents

COMMON NAME	EFFECT	TIME TO EFFECT
Tabun (GA) Sarin (GB) Soman (GD) V-Agents	Lethal nerve agents	Inhalation: Seconds to Minutes Topical: Minutes
Hydrogen cyanide	Lethal blood agent	Minutes
Mustard Lewisite	Blister agents	1 to 12 Minutes Minutes
LSD and BZ	Incapacitating agents	15 to 60 Minutes
Phosgene Chlorine	Lung-damaging (choking)	Minutes

Table 1-6. Some of the Nations Known or Suspected of Having Chemical Weapons

United States of America	People's Republic of China
Russia	North Korea
France	Egypt
Libya	Israel
Iraq*	Taiwan
Syria	Burma
Iran	Ethiopia

* Following the Persian Gulf War (1990-91), the United Nations (UN) began destroying CW munitions discovered during inspection visits to Iraq by UN arms control inspectors. Included among the CW munitions discovered were some 2000 aerial bombs and 6200 artillery shells filled with mustard and several thousand 122mm rocket warheads filled with GB. Iraq also declared SCUD warheads filled with GB and GF.

(2) The Russian Republic of the former Soviet Union has the most extensive CW capability in Europe. Chemical strikes can be delivered with almost any type of conventional fire support weapon system (from mortars to long range tactical missiles). Agents known to be available in the Russian inventory include nerve agents (VX, thickened VX, GB, thickened GD); vesicants (thickened Lewisite and a mustard-Lewisite mixture); and choking agent (phosgene). Although not considered CW agents, riot control agents are also in the Russian inventory.

CHAPTER 2

NUCLEAR, BIOLOGICAL, AND CHEMICAL WEAPONS EFFECTS

2-1. General

Nuclear weapons are the most destructive weapons available for use on the battlefield today. Biological agents are easy to disperse on the battlefield without immediate detection; however, their effects on exposed troops can change the course of the battle. As more nations enter the arena of developing biological and chemical weapons, their potential effects on our troops will increase. Biological and chemical weapons/agents may be employed by terrorists, or in any level of conflict (low-, mid-, or high-intensity). Consideration of both the physical and biological effects of these weapons is required for HSS operations.

2-2. Physical Effects of Nuclear Weapons

a. The principal physical effects of nuclear weapons are blast, thermal radiation (heat), and nuclear radiation. These effects are dependent upon the yield (or size) of the weapon expressed in kilotons (KT), physical design of the weapon (such as conventional and enhanced), and upon the method of employment. For a low altitude detonation of a moderate-sized (3 to 10 KT) weapon, the energy is distributed (Figure 2-1) as follows:

(1) Fifty percent as blast.

(2) Thirty-five percent as thermal radiation; made up of a wide spectrum of electromagnetic radiation, including infrared, visible, and ultraviolet light and some soft x-ray radiation.

(3) Fourteen percent as nuclear radiation, 4 percent as initial ionizing radiation composed of neutrons and gamma rays emitted within the first minute after detonation, and 10 percent as residual nuclear radiation (fallout).

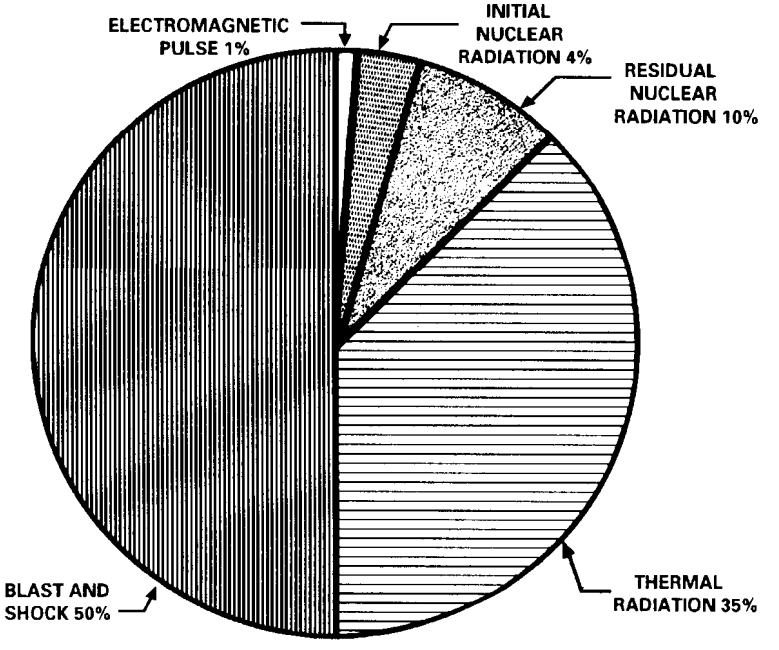


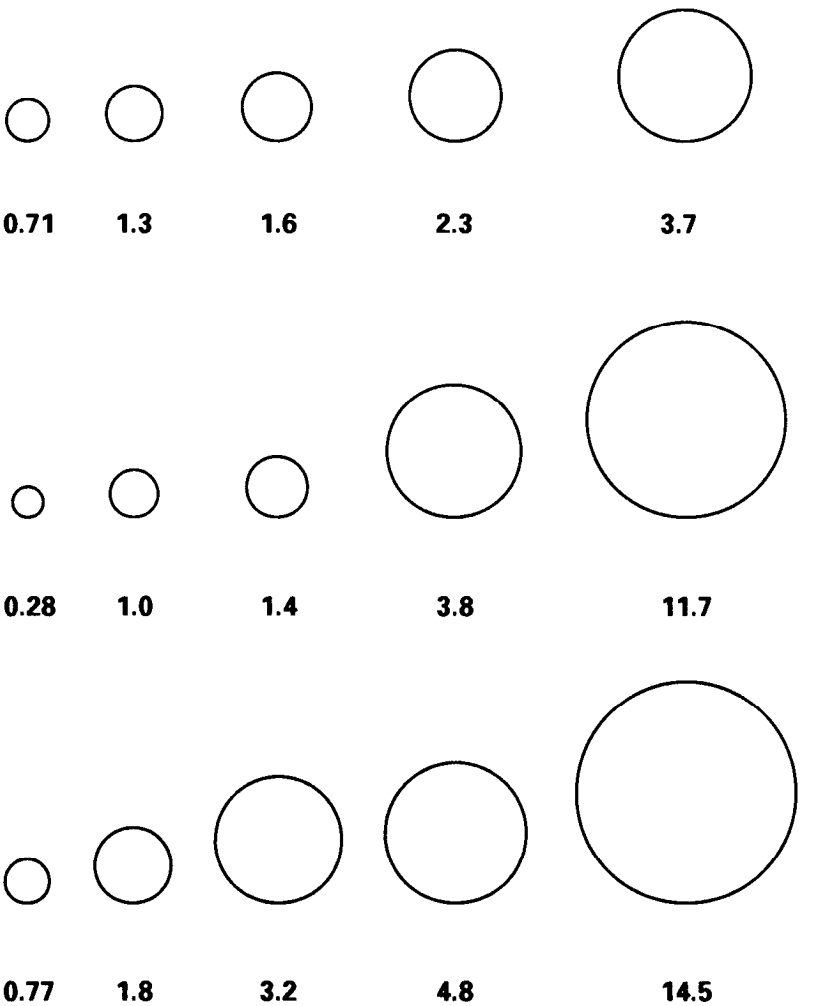
Figure 2-1. Distribution of energy.

(4) One percent as EMP.

b. Larger weapons are more destructive than smaller weapons, but the destructive effect is not linear. Table 2-1 presents a comparison of three aspects of nuclear weapons effects with yield.

Table 2-1. Comparison of Weapons Effects (Radii of Effects in Kilometers—Airburst)

	1 KT	20 KT	100 KT	1 MT	10 MT
NUCLEAR RADIATION (1,000 cGy)	0.71	1.3	1.6	2.3	3.7
BLAST (50% INCIDENCE OF TRANSLATION WITH SUBSEQUENT IMPACT WITH A NON-YIELDING SURFACE)	0.28	1.0	1.4	3.8	11.7
THERMAL (50% INCIDENCE OF 2ND-DEGREE BURNS TO BARE SKIN, 10 KM VISIBILITY)	0.77	1.8	3.2	4.8	14.5



c. The effects of blast, heat, and nuclear radiation are also determined by the altitude at which the weapon is detonated. Nuclear blasts are classified as air, surface, or subsurface bursts.

(1) An airburst is a detonation in air at an altitude below 30,000 meters, but high enough so that the fireball does not touch the surface of the earth. The altitude is varied to obtain

the desired tactical effects. Initial radiation will be a significant hazard, but there is essentially no local fallout. The ground immediately below the airburst may have a small area of neutron-induced radioactivity. This may pose a hazard to troops passing through the area.

(2) A surface burst is a detonation in which the fireball actually touches the land or water surface. In this case, the area affected by blast, thermal radiation, and initial nuclear radiation will be smaller than for an airburst of comparable yield; however, in the region around ground zero, the destruction will be much greater and a crater is often produced. Additionally, a significant amount of fallout is created and can be a hazard downwind.

(3) *A* subsurface burst is an explosion in which the detonation is below the surface of land or water. Cratering usually results. If the burst does not penetrate the surface, the only hazard is from the ground or water shock. If the burst penetrates the surface, blast, thermal, and initial nuclear radiation will be present, though less than for a surface burst of comparable yield. Local fallout will be heavy over a small area.

2-3. Physiological Effects of Nuclear Weapons

The physiological effects of nuclear weapons result from: direct physical effects from the blast; the thermal radiation; the ionizing radiation (initial or residual); or a combination of these. For smaller weapons (less than 10 KT), ionizing radiation is the primary creator of casualties requiring medical care, while for larger weapons (greater than 10 KT), thermal radiation is the primary cause of injury.

a. The rapid compression and decompression of blast waves on the human body results in transmission of pressure waves through the tissues. Resulting damage *is* primarily at junctions between tissues of different densities (bone and muscle), or at the interface between tissue and airspace. Lung tissue and the gastrointestinal system (both contain air) are particularly susceptible to injury. The tissue disruptions can lead to severe hemorrhage or to air embolism; either can be rapidly fatal. Direct overpressure effects do not extend out as far from the point of detonation and are often masked by the drag force effects. Atypical range of probability of lethality, with variation in overpressure for a 1 KT weapon, is shown in Table 2-2.

Table 2-2. Range of Lethality of Peak Overpressures

LETHALITY (APPROXIMATE %)	PEAK OVERPRESSURE (ATMOSPHERES)	DISTANCE FROM GROUND ZERO; METERS
1	2.3 - 2.9	150
50	2.9 - 4.1	123
100	4.1 +	110

(1) The significance of the data is that the human body is relatively resistant to static overpressure compared to rigid structures such as buildings. For example, an unreinforced cinder block panel will shatter at 0.1 to 0.2 atmospheres.

(2) Overpressures lower than those in Table 2-2 can cause nonlethal injuries such as lung damage and eardrum rupture. Lung damage is a relatively serious injury, usually requiring hospitalization, even if not fatal; whereas eardrum rupture is a minor injury, often requiring no treatment at all.

(a) The threshold level of overpressure for an unreinforced, unreflected blast wave which can cause lung damage is about 1.0 atmosphere.

(b) The threshold level for eardrum rupture is around 0.2 atmospheres; the overpressure associated with a 50 percent probability of eardrum rupture is about 1.1 atmospheres.

(3) Casualties requiring medical treatment from direct blast effects are produced by overpressures between 1.0 and 3.5 atmospheres. However, other effects (such as indirect blast injuries and thermal injuries) are so predominate that patients with only direct blast injuries make up a small part of the patient work load.

b. The drag forces (indirect blast) of the blast winds are proportional to the velocities and duration of the winds. The winds are relatively short in duration, but can reach velocities of several hundred kilometers (km) per hour, Injury can result either from missiles impacting on the body, or from the physical displacement of the body against objects and structures.

(1) The distance from the point of detonation at which severe indirect injury occurs is greater than that for equally serious direct blast injuries. A high probability of serious indirect injury can occur when the peak overpressure is about 0.2 atmospheres. This range will increase with the increased size of the weapon; for a 1 KT weapon the range is 0.22 km, whereas for a 20 KT weapon, the range is 0.76 km. Injuries will occur and casualties will be generated at greater ranges, but not consistently.

(2) The drag forces of the blast winds produced by a nuclear detonation are so great that almost any form of vegetation or structure will be broken up or fragmented into missiles. Thus, multiple, varied missile injuries will be common, increasing their overall severity and significance. Table 2-3 lists ranges at which significant missile injuries can be expected.

Table 2-3. Ranges for Probabilities of Injury from Small Missiles

YIELD (KT)	RANGES (KM) 1% PROBABILITY OF SERIOUS INJURY	50% PROBABILITY OF SERIOUS INJURY	99% PROBABILITY OF SERIOUS INJURY
1	0.28	0.22	0.17
10	0.73	0.57	0.44
20	0.98	0.76	0.58
50	1.4	1.1	0.84
100	1.9	1.5	1.1
200	2.5	1.9	1.5
500	3.6	2.7	2.1
1000	4.8	3.6	2.7

1 Incidence of injury based on incidence of perforation of skin and tissue.
2 Missiles used were 10 gram (gm) in weight.

(3) *The* velocity to which missiles are accelerated is the major factor in causing injury. The probability of a penetration injury increases with increasing velocity, particularly for small, sharp missiles such as glass fragments. Small, light objects are accelerated to speeds approaching the maximum (wind) velocity. Table 2-4 shows data for probability of penetration related to size and velocity of glass fragments.

Table 2-4. Probability of Penetration of Glass Fragments into Abdominal Cavity

MASS OF GLASS FRAGMENTS (GM)	1%	50%	99%
	IMPACT VELOCITY (METERS PER SECOND)		
0.1	78	136	243
0.6	53	91	161
1.0	46	82	143
10.0	38	60	118

(4) Heavy, blunt missiles may not penetrate, but can result in significant injury, particularly fractures. The threshold velocity for skull fractures from a 4.5 milligram (mg) missile is about 4.6 meters/second.

(5) The drag forces of the blast winds are strong enough to displace even large objects (such as vehicles), or to cause the collapse of large structures (such as buildings) resulting in serious crushing injuries. Man himself can become a missile. The resulting injuries sustained are called translational injuries. The velocity at which the body is displaced will determine the probability and the severity of injury. Assuming a displacement of 3.0 meters, the impact velocity associated with various degrees of injury is shown in Table 2-5. The velocities in Table 2-5 can be correlated against yield. The ranges at which such velocities would be found are given in Table 2-6.

Table 2-5. Translational Injuries

A. BLUNT INJURIES AND FRACTURES

PROBABILITY OF INJURY	VELOCITY (M/SEC)
1%	2.6
50%	6.6
99%	16.5

B. FATAL INJURIES

PROBABILITY OF FATALITY	VELOCITY (M/SEC)
1%	6.6
50%	17.0
99%	39.7

Table 2-6. Ranges for Selected Impact Velocities of a 70 Kilogram Human Body Displaced by Blast Wind Drag Forces for Different Yield Weapons

WEAPON YIELD (KT)	VELOCITIES (m/sec) 2.6	6.6	17.0
	RANGES (km)		
1	0.38	0.27	0.19
10	1.0	0.75	0.53
20	1.3	0.99	0.71
50	1.9	1.4	1.0
100	2.5	1.9	1.4
200	3.2	2.5	1.9
500	4.6	3.6	2.7
1000	5.9	4.8	3.6

2-4. Biological Effects of Thermal Radiation

The thermal radiation emitted by a nuclear detonation causes burns in two ways—by direct absorption of the thermal energy through exposed surfaces (flash burns); or by the indirect action of fires in the environment (flame burns). Indirect flame burns can easily outnumber all other types of injury.

a. Thermal radiation travels outward from the fireball in a straight line; therefore, the amount of energy available to cause flash burns decreases rapidly with distance. Close to the fireball all objects will be incinerated. The range for 100 percent lethality will vary with yield, height of burst, weather, environment, and immediacy of treatment. The critical factors determining the degree of burn injury are the flux (calories per square centimeter [cal/cm^2]) and the duration of the thermal pulse. The amount of thermal radiation needed to cause a flash second-degree burn on exposed skin will vary with the yield of the weapon and the nature of the pulse (Table 2-7).

NOTE

The battle-dress uniform, mission-oriented protective posture (MOPP) gear, or any other clothing will provide additional protection against flash burns. The airspaces between the clothing significantly impede heat transfer and may prevent or reduce the severity of burns, depending on the magnitude of the thermal flux.

Table 2-7. Factors for Determining the Probability of Second-Degree Burns

YIELD OF WEAPON	1 KT	10 KT	100 KT	1 MT	10 MT
Range (km) for production of second-degree burns on exposed skin	0.78	2.1	4.8	9.1	14.5
Duration of thermal pulse in seconds	0.12	0.32	0.9	2.4	6.4
Cal/cm² required to produce second-degree burns on exposed skin	4.0	4.5	5.3	6.3	7.0

b. Indirect (flame) burns result from exposure to fires caused by the thermal effects in the environment, particularly from ignition of clothing. The larger-yield weapons are more likely to cause fire storms over extensive areas. There are too many variables in the environment to predict either incidence or severity of casualties. Expect the burns to be far less uniform (in degree) and not limited to exposed surfaces. For example, the respiratory system may be exposed to the effects of hot gases produced by extensive fires. Respiratory system burns cause high morbidity and high mortality rates.

c. The initial thermal pulse can cause eye injuries in the forms of flash blindness and retinal scarring. Flash blindness is caused by the initial brilliant flash of light produced by the nuclear detonation. This flash swamps the retina, bleaching out the visual pigments and producing temporary blindness. During dayhght hours, this temporary effect may last for about 2 minutes. At night, with the pupil dilated for dark adaptation, flash blindness will affect personnel at greater ranges and for greater durations. Partial recovery can be expected in 3 to 10 minutes, though it may require 15 to 35 minutes for full night adaptation recovery. Retinal scarring is the permanent damage from a retinal burn. It will occur only when the fireball is actually in the individual's field of view and should be a relatively uncommon injury. The location of the scar will determine the degree of interference with vision. Figure 2-2 presents the threshold distance for minimal eye injuries.

2-5. Physiological Effects of Ionizing Radiation

A nuclear burst results in four types of ionizing radiation: neutrons, gamma rays, beta, and alpha radiation. The initial burst is characterized by neutrons and gamma rays while the residual radiation is primarily alpha, beta, and gamma rays. The effect of radiation on a living organism varies greatly by the type of radiation the organism is exposed to. See Table 2-8 for characteristics of nuclear radiation.

a. Alpha particles are extremely massive charged particles (four times the mass of a neutron); they are a fallout hazard. Because of their size, alpha particles cannot travel far and are fully stopped by the dead layers of the skin or by the uniform. Alpha particles area negligible external hazard, but if inhaled or ingested, can cause significant internal damage.

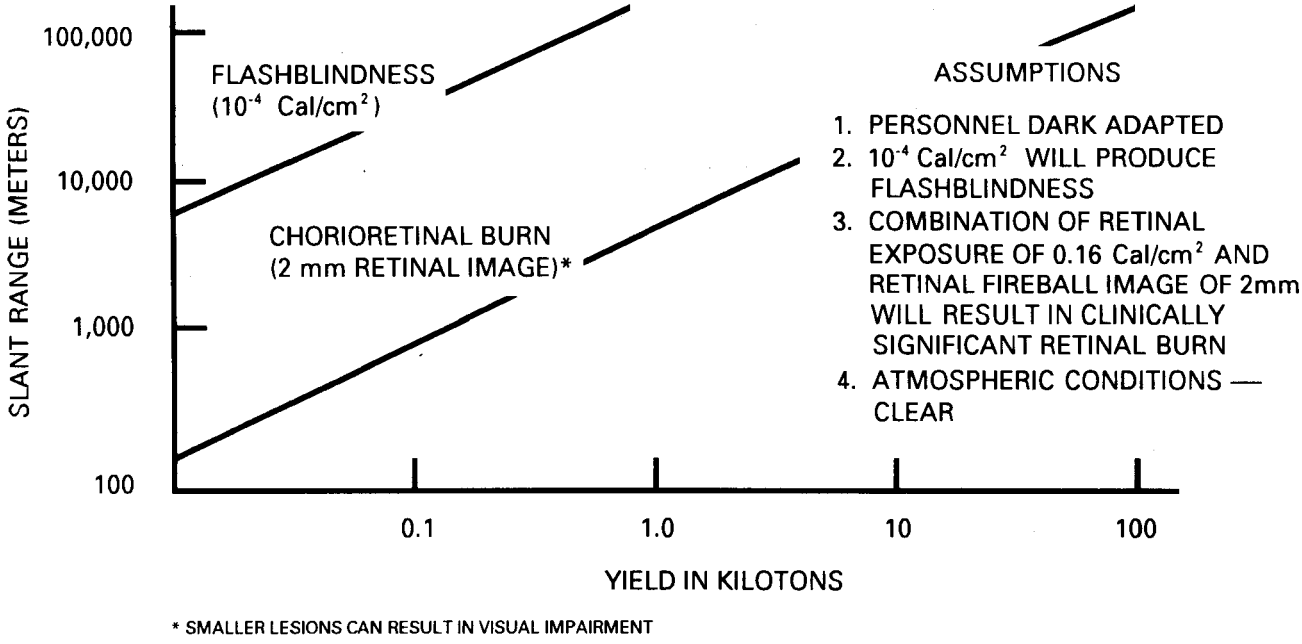


Figure 2-2. Threshold distance for minimal chorioretinal burn and flash blindness versus yield (airburst) at night.

Table 2-8. Characteristics of Nuclear Radiation

NAME AND SYMBOL	WHAT IS IT	SOURCE	ENERGY AND SPEED	RANGE IN AIR	RANGE IN TISSUE	SHIELDING REQUIRED	BIOLOGICAL HAZARD
α ALPHA PARTICLE	HELIUM NUCLEUS	DECAY OF URANIUM AND PLUTONIUM	ENERGY VARIES: SPEED VARIES FROM 1/20 TO 1/10 SPEED OF LIGHT	$\sim$ 5 cm	CANNOT PENETRATE THE EPIDERMIS	NONE	NONE, UNLESS INGESTED OR INHALED IN SUFFICIENT QUANTITIES
β BETA PARTICLE	HIGH-SPEED ELECTRON	DECAY OF FISSION PRODUCTS AND NEUTRON INDUCED ELEMENTS	VARIES	5 METERS	SEVERAL LAYERS OF SKIN	STOPPED BY A FEW cm OF A1 OR MODERATE CLOTHING	SUPERFICIAL SKIN INJURY
γ GAMMA RAY	ELECTRO-MAGNETIC ENERGY	DECAY OF FISSION PRODUCTS AND NEUTRON INDUCED ELEMENTS	ENERGY VARIES: TRAVELS AT THE SPEED OF LIGHT	UP TO 500 METERS, BUT IS ENERGY DEPENDENT	VERY PENETRATING, BUT IS ENERGY DEPENDENT	DENSE MATERIAL, SUCH AS CONCRETE, STEEL PLATE, EARTH	WHOLE BODY INJURY, MANY CASUALTIES POSSIBLE
η NEUTRON	UNCHARGED PARTICLE	FISSION AND FUSION REACTIONS	VARIES	LESS THAN GAMMA, BUT IS ENERGY DEPENDENT	VERY PENETRATING, BUT IS ENERGY DEPENDENT	HYDROGENOUS MATERIALS, SUCH AS WATER OR DAMP EARTH	WHOLE BODY INJURY, MANY CASUALTIES POSSIBLE

b. Beta particles are very light, charged particles that are found primarily in fallout radiation. These particles can travel a short distance in tissue; if large quantities are involved, they can produce damage to the basal stratum of the skin. The lesion produced is similar to a thermal burn (called a beta burn).

c. Gamma rays, emitted during the nuclear destination and in fallout, are uncharged radiation similar toi X rays. They are highly energetic and pass through matter easily. Because of its high penetrability, radiation can be distributed throughout the body, resulting in whole body exposure.

d. Neutrons, like gamma rays, are uncharged, are only emitted during the nuclear detonation, and are not a fallout hazard. However, neutrons have significant mass and interact with the nuclei of atoms, severely disrupting atomic structures. Compared to gamma rays, they can cause 20 times more damage to tissue.

e. When radiation interacts with atoms, energy is deposited resulting in ionization (electron excitation). This ionization may involve certain critical molecules or structures in a cell, producing its characteristic damage. Two modes of action in the cell are direct and indirect action. The radiation may directly hit a particularly sensitive atom or molecule in the cell. The damage from this is irreparable; the cell either dies or is caused to malfunction. The radiation can also damage a cell indirectly by interacting with water molecules in the body. The energy deposited in the water leads to the creation of toxic molecules; the damage is transferred to and affects sensitive molecules through this toxicity.

f. The two most radiosensitive organ systems in the body are the hematopoietic and the gastrointestinal systems. The relative sensitivity of an organ to direct radiation injury depends upon its component tissue sensitivities. Cellular effects of radiation, whether due to direct or indirect damage, are basically the same for the different kinds and doses of radiation. The simplest effect is cell death. With this effect, the cell is no longer present to reproduce and perform its primary function. Changes in cellular function can occur at lower radiation doses than those which cause cell death. Changes can include delays in phases of the mitotic cycle, disrupted cell growth, permeability changes, and changes in motility. In general, actively dividing cells are most sensitive to radiation. Additionally, radiosensitivity tends to vary inversely with the degree of differentiation of the cell.

g. Predicting radiation effects is difficult because often it is unknown which organ was exposed. Thus, most predictions are based on whole body irradiation. Partial body and specific organ irradiation can also occur; particularly from fallout particles or internal deposits. Depending upon the organ system, the irradiation can be severe. The severe radiation sickness resulting from external, whole body irradiation and its consequent organ effects, is a primary medical concern. The median lethal dose of radiation which will kill 50 percent of the exposed persons within a period of 60 days, without medical intervention (designated as LD50/60), is approximately 450 centigray (cGY).

h. Recovery of a particular cell system is possible if a sufficient fraction of a given stem cell population remains after radiation injury. Complete recovery may appear to occur; however, it is possible for late somatic effects to have a higher probability of occurring because of the radiation damage.

2-6. Effects of Biological Weapons

Biological warfare is the intentional use, by an enemy, of live agents or toxins to cause death and disease among personnel, animals, and plants, or to deteriorate materiel.

a. Live Agents.

(1) Live agents are living organisms like viruses, bacteria, and fungi. They can be delivered directly (artillery or aircraft spray), or through a vector such as a flea or tick. Modern technology has eliminated some unpredictable aspects of live agent use, making weaponization more likely.

(2) For some agents, only a few organisms are needed to cause infection, especially when inhaled. Live agents are small and light; they can be spread great distances by the wind and can float into unfiltered or nonairtight places.

(3) Live agents require time after they are ingested to multiply enough to overcome the body's defenses. This incubation period may vary from hours to days or weeks depending on the type of organism. Thus, to be effective, alive agent attack would need to be launched well in advance of a tactical assault.

(4) These agents also have life cycles in which to grow, reproduce, age, and die. While they live, these agents usually require protection and nutrition supplied by another living organism (the host) to survive and grow. Weathering (wind, rain, and sunlight) rapidly reduces their numbers. Some bacterial agents produce spores that can form protective coats and survive longer. However, the hazard from most live agents may only last for one day.

(5) Live agents are not detectable by any of the five physical senses; usually the first indication of a biological attack is the ill soldier. The diseases caused by live agents may be difficult to control because they are often easily spread from soldier to soldier, directly or indirectly.

(6) Because of their incubation period and life cycle, likely areas for live agent use are in the combat service support (CSS) area. But attacks in the forward areas cannot be ruled out.

b. Toxins.

(1) Toxins are by-products (poisons) produced by plants, animals, or microorganisms. It is the poisons that harm man, not the organisms which make the toxins. In the past, the only way to deliver toxins on a large scale was by using the organism. With today's technology large quantities of many toxins can be produced; thus, they can be delivered without the accompanying organism.

(2) Toxins have several desirable traits. They are poisonous compounds that do not grow, reproduce, or die after they have been dispersed; they are more easily controlled than live organisms. Field monitors capable of providing prompt warning of a toxin attack are not available; therefore, soldiers must learn to quickly recognize signs of attack, such as observing unexplained symptoms of victims. Toxins produce effects similar to those caused by chemical agents; however, the victims will not respond to the first aid measures that work against chemical agents. Unlike live agents, toxins can penetrate the unbroken skin; when mixed with a skin `penetrant such as dimethyl sulfoxide, their speed of penetration is increased. Because the effects on the body are direct, the symptoms of an attack may appear very rapidly. The potency of most toxins are such that very small doses will cause injuries and/or death. Thus, their use by an enemy may be an alternative to chemical agents because it allows the use of fewer resources to cover the same or a larger area. Slight exposure at the edges of an attack area may produce severe symptoms or death from exposure to toxins because of their extreme toxicity. Lethal or injury downwind hazard zones for toxins may be far greater than those of CW agents.

2-7. Behavior of Biological Weapons

Biological agents can be disseminated in a spectrum of physical states. They may be living microorganisms or spore forms of the organism. See Table 2-9 for stability of various biological agents. They may be spread by—

- Arthropods.
- Contact with infected animals.
- Contamination of food and water.
- Aerosol, liquid, or solid dispersion.

The only requirement is that they must be stable enough to survive transport and dissemination. The toxicity of biological agents is not the same for everyone; each individual does not react exactly the same way to the same amount of an agent. Some are more resistive than others because of race, sex, age, or other factors. The dose is the quantity of a biological agent received by the subject. The penetration of agents by various routes need not be accompanied by irritation or damage to the absorbent surface, but there are often unique signs and symptoms identifiable either with the inhalation, ingestion, or percutaneous route of entry.

a. Spray dispersion of biological agents often enter the body through the respiratory tract (inhalation injury). The agent may be absorbed by any part of the respiratory tract from the mucosa of the nose and mouth to the alveoli of the lungs.

b. Droplets of liquid and (less commonly) solids may be absorbed from the surface of the skin, digestive tract, and mucous membranes. Agents penetrating the skin may form temporary reservoirs under the skin.

c. Contaminated food and water can produce casualties when ingested.

Table 2-9. Types and Characteristics of Some Biological Agents

TYPE OF AGENT	STABILITY	INCUBATION TIME	ENTRANCE	
			AEROSOL	NONAEROSOL
Anthrax	High	1 to 6 days	Inhalation	Skin, Mouth
Botulinum toxin	High	24 to 36 hours	Inhalation	Mouth, Wound
Brucellosis	High in wet environment	1 to 4 weeks	Inhalation	Mouth, Skin, Eyes
Cholera	Moderate	Hours to 5 days		Mouth
Plague (Pneumonic)	Low	2 to 3 weeks	Inhalation	
Plague (Bubonic)	Moderate	2 to 10 days		Bite of Vector
Ricin	High	<36 hours	Inhalation	Mouth
Staphylococcal Enterotoxin B	High	1 to 6 hours	Inhalation	Mouth
Trichothecene Mycotoxin	High	Minutes to hours	Inhalation	Mouth, Skin
Tularemia	Low	2 to 10 days	Inhalation	Mouth, Skin

2-8. Effects of Chemical Weapons

a. A chemical agent is a chemical which is used to kill, seriously injure, or incapacitate man because of its physiological effects. They can be disseminated by artillery, aircraft, rocket, or by nonconventional means used by terrorists. When first employed in combat during World War I, the chemical weapon (chlorine) was so effective that the attacking Germans were not prepared to exploit the success.

b. Chemical agents are very effective weapons against poorly trained and equipped forces; however, they are less effective against well-trained forces.

2-9. Behavior of Chemical Weapons

Chemical agents can be disseminated as a gas, vapor, or aerosol under ambient conditions. They have a range of odors varying from none to highly pungent characteristics. Their stability is dependent upon the environmental conditions in the area of employment. See Table 2-10 for persistency of various chemical agents.

a. The toxicity of a chemical agent is not the same for everyone; each individual does not react exactly the same way to the same amount of an agent. Some are more resistive than others because of physiological factors. The dose is the quantity of a chemical received by the individual for percutaneous or oral doses and as a time weighted concentration, milligrams-minute/m^3, for inhalation. It is usually expressed as milligrams of agent per kilogram of subject body weight (mg/kg). The LD50 is the dose which kills 50 percent of the exposed population. The ID50 is the incapacitation dose for 50 percent of the exposed subjects. The penetration of agents by various routes need not be accompanied by irritation or delayed supertilcial damage to the absorbent surface, but there are often unique signs and symptoms identifiable by the route of entry.

(1) Gaseous, vapor, and aerosol chemical agents often enter the body through the respiratory tract (inhalation injury). The agent may be absorbed by any part of the respiratory tract from the mucosa of the nose and mouth to the alveoli of the lungs. Aerosol particles larger than 5 microns *(μ)* tend to be retained in the upper respiratory tract; particles in the 1 to 5 μ range are retained in the deep volume of the lungs; while those below 1 μ tend to be breathed in and out again, although a few are retained in the deep volume of the lungs.

(2) Vapors and droplets of liquids can be absorbed from the surface of the skin and mucous membranes. Toxic compounds which are harmful to the skin can produce their effects in liquid or solid state. Agents penetrating the skin may form temporary reservoirs under the skin; the vapors of some volatile liquids can penetrate the skin and cause intoxication. Additionally, wounds and abrasions may present areas which are more permeable than intact skin.

b. Chemical agents may be divided into two main categories which describe how long they are capable of producing casualties—persistent and nonpersistent. Table 2-9 lists the types and characteristics of common chemical agents.

(1) Persistent agents continue to present a hazard for considerable periods (days) after delivery by remaining as a contact hazard, or by slowly vaporizing to produce a hazard by inhalation.

(2) Nonpersistent agents disperse rapidly after release and present an immediate, short duration (hours) hazard. They are released as airborne particles, aerosols, and gases.

Table 2-10. Types and Characteristics Chemical Agents

TYPE OF AGENT	SYMBOL	PERSISTENCE SUMMER	PERSISTENCE WINTER	RATE OF ACTION	ENTRANCE VAPOR/AEROSOL	ENTRANCE LIQUID
NERVE	GA, GB, GD	10 min-24 hr	2 hr-3 days	Very Quick	Eyes, Lungs	Eyes, Skin, Mouth
	VX	2 days-1 wk	2 days-weeks	Quick	Eyes, Lungs	Eyes, Skin, Mouth
CHOKING	CG, DP	1 to 10 min	10 min-1 hr	Immediate	Lungs	Eyes
BLISTER	HD, HN	3 days-1 wk	Weeks	Slow	Eyes, Skin, Lungs	Eyes, Skin
	L, HL	1-3 days	Weeks	Quick	Eyes, Skin, Lungs	Eyes, Skin, Mouth
	CX	Days	Days	Very Quick	Eyes, Lungs, Skin	Eyes, Skin, Mouth
BLOOD	AC, CK	1-10 min	10 min-1 hr	Very Quick	Eyes, Lungs	Eyes, Mouth, Injured Skin

2-10. Characteristics of Chemical Agents

The effectiveness of a chemical agent is a measure of how much agent is required to produce the desired effect. Thus, an agent which is toxic at a lower dose than another similar agent is more effective. Besides dose required for a given effect, persistency may be used to measure effectiveness. Persistency depends on the agent's physical characteristics, the amount of agent delivered, its physical state, weapons system used, the terrain, and weather in the target area. The desired effects will determine the physical, chemical, and toxicological properties of the chemical agent employed.

a. Nerve agents are primarily organophosphorus esters similar to insecticides. Those of military importance are combined under this term. Although some have been given names, they are usually known by their code letters: GA (TABUN); GB (SARIN); GD (SOMAN); and VX. They are all liquids, varying in volatility that is in a range between gasoline and heavy lubricating oil. Their freezing points are -40 degrees Celsius or lower.

(1) Liquid nerve agents are pale yellow to colorless and are almost odorless. They are moderately soluble in water and highly soluble in lipids (oil). They are rapidly destroyed by strong alkalies and chlorinating compounds. Normal clothing is readily penetrated by liquid or vapor agents. Butyl rubber and synthetic material are more resistant than natural fibers. Agents can penetrate into nonabsorbent material such as web belts and can continue to present a hazard by resorption (off-gassing) of the vapor. Although, local sweating and twitching may occur, usually there is no local irritant change after cutaneous exposure; although, local sweating or twitching may occur. Toxicity depends upon the route of entry and physical characteristics.

(2) Nerve agents strongly inhibit the cholinesterase enzymes. When acetylcholine is released by the nerve junction, it is hydrolyzed by the enzyme. Acetylcholine is the chemical mediator for transmission of the nerve impulses in numerous synapses of the central nervous system (CNS) and the autonomic nervous system and at the endings of the cholinergic nerves (for example: affecting the smooth muscles of the iris, ciliary, bronchial tree, and gastrointestinal tract). The inhibition& cholinesterase by nerve agents is almost irreversible, so the effects are prolonged. Until the cholinesterase level is restored to normal, there is an increased susceptibility to nerve agent exposure. During this time, the effects of repeated exposure are cumulative and the patient may feel "subpar" (for example: tired, fatigue easily, poor appetite, impaired concentration) until recovery is complete.

(3) Nerve agent poisoning is easily identified by the characteristic signs and symptoms as follows:

(a) **MILD** symptoms (self-aid). Casualties with MILD symptoms may experience most or all of the following:

- Unexplained runny nose.
- Unexplained sudden headache.
- Sudden drooling.
- Difficulty in seeing (dimness of vision) (miosis).
- Tightness in the chest or difficulty in breathing.
- Localized sweating and muscular twitching in the contaminated area.
- Stomach cramps.
- Nausea.

(b) Casualties with **MODERATE** symptoms (buddy aid) will experience an increase in the severity of most or all of the MILD symptoms. Especially prominent will be an increase in fatigue, weakness, and muscle fasciculations. The progress of symptoms from MILD to MODERATE indicates either inadequate atropine treatment or continuing exposure to agent.

(c) **SEVERE** symptoms (buddy aid). Casualties with SEVERE symptoms may experience most or all of the MILD symptoms, plus most or all of the following:

- Strange orconfusedbehavior.
- Wheezing, dyspnea (severe difficulty in breathng), and coughing.
- Severely pinpointed pupils.
- Red eyes with tearing.
- Vomiting.

- Severe muscular twitching and general weakness,
- Involuntary urination and defecation.
- Convulsions.
- Unconsciousness.
- Respiratory failure.

b. There are three major families of blister agents (vesicants); mustard (HD) and nitrogen mustard (HN), Lewisite (L), and halogenated oximes (CX). Most vesicants (except CX) are relatively persistent. Mustards (HD, HN) can modify the structure of nucleic acids, cellular membranes, and proteins by combining with certain functional groups (particularly the SH-containing enzymes) for which they have an affinity.

(1) The cutaneous syndrome is divided inti four phases: latent, erythema, vesication, and necrosis. Vesicants can penetrate the skin by contact with either liquid or vapor. The latint period is characteristic of the agent. For mustards it is usually several hours, for Lewisite it is short, and for oximes it is negligible. The latent period is also effected by the dose, temperature, and humidity. The symptoms of the erythema phase are red, painful itching followed by painful necrosis that heals slowly.

(2) In the eyes, vesicants produce intense pain and photophobia. Blistering of the eyelids and mucous membranes can result in temporary blindness. Even after recovery, scars on the cornea can reduce visual acuity.

(3) In the respiratory tract, these agents attack the mucous membranes irritating them. They can paralyze vocal chords and can lead to chemical pneumonitis, or possibly death.

(4) Although blister agents can effect other organs and produce deleterious effects, the skin, eyes, and respiratory tract are the principle organs effected.

c. Chemical agents which attack Iungtissue (choking agents) and cause pulmonary edema are classed as lung damaging agents. Choking agents consist of phosgene (CG) and diphosgene (DP), chlorine (CL), and chloropicrin (PS). Phosgene is typical of the lung-damaging agents, it is used as the example here.

(1) Phosgene is a colorless gas which has an odor resembling new mownhay. Although effects are primarily confined to the lungs, phosgene may also cause mild irritation of the eyes and upper respiratory tract. Phosgene causes a shift in the membrane potential of the alveoli allowing the passage of fluid into the alveoli, resulting in massive pulmonary edema and severely impairing the exchange of O_2 and CO_2 between the capillary blood and the alveolar air.

(2) Initially hypoxemia occurs and is followed shortly by hyperventilation when the frothy edema fluid fills the bronchiole and CO_2 expiration stops.

(3) Signs and symptoms during and immediately following exposure are coughing, tightness of chest, nausea, occasionally vomiting, headache, and lacrimation (tearing).

d. Blood agents consist of hydrogen cyanide (AC) and cyanogen chloride (CK); both are readily absorbed by the mucous membranes and the intact skin. The odor of AC resembles bitter almonds, but many people cannot detect it. Detecting the odor of CK is difficult because of its irritating and lacrimatory effects. It is also poorly absorbed by the metallic salt-impregnated charcoal filters in the protective mask. These agents inhibit certain enzymes (particularly cytochrome oxidase) which are important for oxidation-reduction in the cells; therefore, cell respiration is inhibited and oxygen carried by the hemoglobin is not consumed causing the venous blood to remain bright red. Initial symptoms are characterized by violent convulsions, increased deep respiratory movements, followed by cessation of respiration within one minute, slowing of heart rate to death. High concentrations exert their effects rapidly; however, if the patient is still alive after the cloud has passed, he will probably recover spontaneously.

e. Incapacitating agents are chemicals which produce a temporary disabling condition that persists for hours to days after exposure to the agent has ceased (unlike that produced by riot control agents). While not required, medical treatment produces a more rapid recovery. Characteristics of these agents are that—

- They are highly potent and logistically feasible.
- They produce their effects mainly by altering or disrupting the higher regulatory activity of the CNS.
- The duration of their effects is hours or days rather than momentary or fleeting.
- They do not seriously endanger life, except in exceedingly high doses.
- They produce no permanent injury.

The two types likely to be encountered are CNS depressants and CNS stimulants.

(1) Central nervous system depressants are compounds that have a predominant effect of depressing or blocking the activity of the CNS; often by interfering with the transmission of information across synapses. The action of acetylcholine, both peripherally and centrally, appears to be blocked by BZ. Low doses disrupt higher integrative functions of memory, problem solving, attention, and comprehension. High doses produce toxic delirium which destroys the ability to perform any military task. Within the CNS, BZ seems to produce its effects in the same way as atropine. Small doses cause sleepiness and decreased alertness with elevated heart rate, dry skin and eyelids, drowsiness, increased pupil size, and elevated skin temperatures. Progressive intoxication is marked by an inability to respond effectively to the environment (4 to 12 hours), followed by increasing activity and random/unpredictable behavior (12 to 96 hours). Because the patient cannot sweat, heat stress becomes a problem.

(2) Central nervous system stimulants are agents that cause excessive nervous activity, often by boosting or facilitating transmission of impulses across synapses. me effect is to “flood" the cortex and other higher regulatory centers with too much information, making concentration difficult and causing indecisiveness and an inability to act. These include d-lysergic acid diethylamide (LSD), psilocybin, and mescaline. Intoxication shows sympathetic stimulation (rapid heart rate, sweaty palms, pupillar enlargement, and cold extremities) and mental excitation (nervousness, trembling, anxiety, and inability to relax or sleep); feelings of tension, exhilaration, heightened awareness, paranoid ideas, and profound states of terror may also occur.

CHAPTER 3

COMMAND AND CONTROL

3-1. General

Medical tasks are expected to increase significantly on the integrated battlefield. Great numbers of casualties are expected during the initial phases. Combined NBC and conventional weapons injuries will predominate. Early resuscitation, stabilization, and prompt evacuation are mandatory for survival of the wounded. Insufficient medical personnel and medical supplies, along with inadequate evacuation means, will significantly limit HSS. Health service advisers and staff officers must provide guidance to commanders on continued duty for soldiers who have been exposed to NBC weapons effects. Medical unit commanders and their staffs must use command and control to enhance the survivability of HSS assets and the supported force. See Appendix A for guidelines on HSS planning for and operations in an NBC environment.

3-2. Survival of Initial Effects

Nuclear, biological, and chemical weapons are most effective on the untrained, unprepared, unwarned soldier. Health service support commanders must use in-place assets to enhance their unit's training, preparation, and survivability.

a. Medical Intelligence. The Armed Forces Medical Intelligence Center, Fort Detrick, Maryland, maintains a complete data base on the medical threat of any area in the world (see FM 8-10-8). When preparing for deployment, commanders can obtain information on the types of endemic diseases in the area, the biological and chemical agent potential, and other medical threats. Additionally, once deployed, the S2/G2 maintains records regarding NBC use and potential use in the theater. With this information, the HSS commander can brief his troops to enable them to recognize signs and symptoms of possible biological agent use, or endemic disease outbreaks. The commander can also ensure that his troops are either in MOPP or prepared to assume a MOPP when necessary.

b. Vulnerability Analysis. To determine the relative safety of his facility, the commander directs his S2/G2 to conduct a vulnerability analysis of their position. The S2/G2 produces intelligence information about the enemy's NBC equipment and activity; he provides a detailed characteristics review of an area. Weather and terrain information, coupled with the enemy's NBC equipment and doctrine, result in an understanding of whether the environmental factors are conducive to employment of NBC weapons. The S2/S3 coordinates with the supported units to determine the casualty estimates.

c. Mitigation of Initial Effects. If the enemy feels that using NBC weapons would not be effective, he will use other weapons. Thus, hardening a position makes it a less lucrative NBC target. Measures taken to protect a position against nuclear attack are generally effective against chemical, biological, and conventional weapons.

(1) Survival depends on mastery of basic NBC survival skills in the event of NBC attack. The skills include—

- Using procedures to avoid the thermal pulse from a nuclear weapon;
- Wearing of protective clothing;
- Wearing headgear at all times; and
- Practicing good field sanitation and personal hygiene.

(2) Foxholes and bunkers provide excellent personnel protection against nuclear and conventional weapons. Existing natural and man-made terrain features, such as caves, ditches, ravines, culverts, overpasses, tunnels, and empty bunkers, can be used as expedient shelters. The basements of masonry and light steel buildings provide protection from the effects of nuclear weapons. Sealing the doors, windows, and other openings of the general purpose (GP) tent and the tent, expandable, modular, personnel (TEMPER) will increase the protection of personnel and patients inside. The openings can be sealed using tape, sandbagging the bottoms of the GP tent flaps, or covering these areas with plastic sheeting. Although toxic vapors from chemical attacks can enter these closed-in areas, they can provide protection from liquid and particulate contamination, greatly reducing decontamination needs. However, chemical vapors have a tendency to gather in depressions and closed areas; monitoring for vapors must be continuous in these areas.

DANGER

Air blowers without chemical/biological (CB) filters must be turned off when a vapor hazard exists. The vapors will be blown in by the systems if filters are not in place.

(3) The commander must plan for alternate operational sites in case his current site is untenable. He should also provide maximum protective shelter for all off-duty personnel and critical medical equipment and supplies. Cover and concealment is employed during troop movements; also, scheduled stops are near natural/man-made shelters.

(4) All personnel must have their immunizations current for all known endemic diseases in the area of operations. Prophylaxis for suspect biological agents, pretreatments for chemical agents, and all other available protective/pretreatment measures must be planned for and used as prescribed in the tactical standing operating procedure (TSOP) or command directives.

d. Detection of Attack. The NBC warning and reporting system can warn the commander of many attacks, but he must also rely upon his own resources. Each unit has organic equipment to detect nuclear or chemical contamination. Measures that provide warnings of hazards include—

- Placing M9 detector paper on exposed surfaces;
- Placing chemical agent alarms upwind of the unit position; and
- Dispersing radiacmeters among personnel to monitor the arrival of fallout.
- Monitoring patients by HSS personnel for signs of biological agent employment.

The appearance of exotic diseases, or large increases in disease rates are indicators of biological warfare agents employment. Blood or other biological specimens of patients displaying signs of suspect illnesses can be sent to the area medical laboratory and continental United States (CONUS) laboratories for evaluation. All specimens are forwarded through technical intelligence channels.

e. *Mission-Oriented Protective Posture Levels.* Mission-oriented protective posture is the flexible use of protective clothing and equipment balanced against performance degradation. The higher the MOPP level, the more protection it provides and the more it degrades performance. The

commander must weigh the needs of individual protection against unit efficiency. The MOPP level that the unit assumes is based on the threat, temperature, work rate, and mission. The MOPP level used is a balance between the need to prevent NBC casualties and reducing heat and fatigue casualties. The commander specifies a MOPP level before a mission. This level changes as the situation changes or new intelligence is received. Although some mission degradation is unavoidable, the amount of degradation can be reduced by acclimatization and training. Besides the five levels of MOPP, the commander may opt for mask with hood only to be worn. This may be viable in shelters that provide partial protection from direct skin exposure to liquid or solid contamination. Inside the shelter the occupants are exposed to vapor hazards only (keep in mind that mustard vapors can still cause blistering); however, when leaving the shelter they must assume the appropriate MOPP.

f. Strike Warning. Maintaining continuous contact with higher headquarters ensures strike warnings (STRIKWARN) of nuclear or chemical (CHEMWARN) weapons are received and promulgated. As mentioned earlier, NBC weapons have their greatest effect upon untrained and unprepared troops. The STRIKWARN will enable the commander to harden his position against the potential nuclear or chemical weapons effects.

3-3. Management of Residual Effects

The STRIKWARN and intelligence channels provide early warning and enhanced protection from the initial effects of NBC weapons. There are many procedures that reduce the residual effects (contamination and collateral damage) of NBC weapons on the battlefield.

a. *Nuclear, Biological, and Chemical Warning and Reporting System.* The NBC warning and reporting system (NBCWRS) is a rapid means of sending reports of an NBC attack. They inform other affected units of possible contamination. They also report contaminated areas up and down the chain of command and to adjacent units. Each report has a specific purpose and uses standard codes to shorten and simplify the reporting process (for report detail, see FM 3-3). A summary of each report is as follows:

(1) NBC 1: *Observer's Initial Report.* This report is used by the observing unit to give initial and follow-up data about an NBC attack. It is sent by platoons and companies to battalion headquarters, or by designated observers in the case of NBC 1 to division NBC centers (NBCC). Key leaders and NBC specialists in all units must be completely familiar with the NBC 1 report and the information it contains. Battalion and higher elements must consolidate reports and decide which NBC 1 to forward. The unit NBCC is responsible for ensuring the report is in the correct format. The NBC 1 report following the first use of NBC weapons is sent with a FLASH precedence. Subsequent reports are sent with an IMMEDIATE precedence. Only observers designated by the division NBCC send NBC 1 (nuclear) reports. Nuclear attacks can be observed from great distances, Therefore, those units most capable of making accurate measurements are designated as observers.

(2) NBC 2: *Evaluated Data Report.* This report is based on two or more NBC 1 reports. It is used to pass evaluated data to units. Division is usually the lowest level to prepare an NBC 2 report. However, a brigade or battalion might do so, especially during independent operations.

(3) NBC 3: *Warning of Predicted Contamination Report.* The NBCC uses NBC 1 reports and wind information to predict downwind hazard areas. This is disseminated as an NBC 3 report. Each unit evaluates the NBC 3 report, determines which of its subordinate units may be affected, and disseminates the report as required. This report warns the commander when the affected unit may be within a downwind hazard area so the unit may take protective measures.

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(4) NBC 4: *Monitoring and Survey Report.* When a unit detects NBC hazards through monitoring, survey, or reconnaissance, this information is reported as NBC 4 reports from various units and plotted on the NBCC situation map to show where hazards exist. These reports are prepared and submitted by company-level organizations.

(5) NBC 5: *Actual Contaminated Areas Report.* Once the NBC 4 reports are posted on the situation map, an NBC 5 report is prepared showing the contaminated area. The NBC 5 report is usually prepared by the division. The preferred method of dissemination is by map overlay.

(6) *NBC 6: Detailed Information on Chemical /Biological Attack Report.* This report, summarizing information concerning a chemical or biological attack, is prepared at the battalion. It is submitted to higher headquarters only when requested. If desired, it can be sent from higher to lower for information purposes.

b. Predictions. When alerted of possible contamination (through a STRIWARN or NBCWRS), the commander ensures that predictions of potential contamination are constructed. This alerts him to the possibility of his unit being in zones of expected contamination. Based on these predictions or the receipt of an NBC 5 report, the commander alerts his troops to move out, or to prepare to receive contamination to include putting patients into a protective posture.

c. Survey, Detection, and Monitoring. At all levels, selected soldiers are designated as survey team members; these individuals operate available NBC detection equipment. Assignment to these survey teams is an additional duty. The survey teams consist of a primary and an alternate operator for each piece of assigned detection equipment. These teams provide the commander with a picture of the local contamination hazards and where clean areas are located. This data is also forwarded to higher headquarters to become part of the larger NBC picture.

(1) *Survey.* Nuclear, biological, and chemical detection is carried out while performing the unit's assigned missions. Units survey small areas and routes of immediate interest to the commander. Often he requires contamination information not available through routine monitoring to select evacuation routes and alternate unit positions. To this end, the commander may direct the NBC survey teams to check the route or area of interest. An advance party searching for new positions mount automatic chemical agent alarms on their vehicles to detect the presence of chemical agents along the route. However, the M8A1 chemical agent alarm does not operate in the mobile mode; the vehicle must come to a halt to test for chemical agents with this device. Periodically they conduct tests using a chemical agent detection kit. Concurrently, the survey team checks for the presence and level of radiological contamination. Thus, the advance team is able to advise the commander of NBC hazards found along the proposed route. Upon arrival at a proposed position, the survey team checks the area for NBC hazards. If contamination exists, the commander must evaluate the type and degree of the NBC hazard and how it may affect operations.

(2) *Detection.* Once an *NBC* hazard is found, the next step is to identify the hazard. Biological agents require a laboratory facility for identification. Nuclear radiation is measured with the teams' radiac instruments and chemical agents are identified with detector paper and chemical agent detector kits. Chemical agent detector paper (M8/9) is used to detect liquid chemical agents. When the paper is brought into contact with a liquid hazard, the presence of blister or nerve agents is indicated by a color change in the paper. Because petroleum and other substances can cause a similar color change, the M8/M9 paper should be used only as an indicator that chemical agent

hazards may exist. Definitive identification of an agent requires the use of the M256A1 chemical agent detector kit. This kit detects blood, blister, and nerve agent vapors; detection of toxins may also be possible.

(3) *Monitor.* When contamination is found, it is marked to warn unsuspecting personnel. The reconnaissance team marks all likely entry points into NBC hazard areas using the standard NATO NBC marking set and reports the contamination to higher headquarters. The markers are placed facing away from the contamination and close enough to each other so that more than one marker can be seen. The commander may direct that the area not be marked if he determines that markings would help the enemy; however, the hazard must be reported to higher headquarters. Upon discovering a marked contaminated area, elaborate surveys are not required, but merely check the extent of contamination; altering plans may be necessary. As the extent of the hazard is reduced, the signs are relocated; if the hazard is gone, the signs are removed. Any changes are reported to higher headquarters.

d. Management of Contamination. Contamination is used to cause casualties, degrade performance, and restrict the use of terrain. The unit commander must not become preoccupied with the contamination, but must consider the mission; the type and extent of contamination; and anticipated enemy actions when deciding how to manage contamination.

(1) Contamination avoidance. By far, the preferred method is to avoid contaminated areas. Thus, troops do not need to wear complete protective clothing, or use time and resources for decontamination. Bypassing contamination is simpler and safer than going through it. When the entire unit is not needed on a mission in or passing through a contaminated area, consider taking only personnel and equipment required to accomplish the mission. Personnel staying behind can prepare for decontamination of personnel and equipment upon return from the mission. When an NBC hazard is imminent, the commander takes immediate action to determine the type of hazard and its persistency. When the hazard is a nonpersistent chemical agent, the unit continues its mission; the hazard should disappear quickly. When the hazard is persistent (nuclear fallout, suspected biological agent, or persistent chemical agent), the unit maintains full protection; takes actions to limit further exposure to the hazard; and continues the mission. At the same time, the commander considers whether the unit should relocate to a clean, alternate location. When required, preparation to relocate the unit is started. During a relocation, every effort is made to avoid further exposure to the contamination. If the decision is made to remain in the contaminated area, the hazard must be lessened or avoided as much as possible.

(2) Collective protection. Collective protection systems reduce the degradation caused by wearing MOPP; they eliminate the need to wear MOPP while continuing with the mission in a contamination hazard area.

(a) Types of collective protection systems for chemical/biological agents include the ventilated facepiece, overpressure, hybrid, and total protection. The ventilated facepiece provides filtered air through hoses to the individual mask. Mission-oriented protective posture is still worn, but the forced air supplied to the mask reduces the breathing resistance caused by the mask. Overpressure systems include an enclosure with filtered air that removes NBC contamination, allowing the occupants to work in shirt sleeves. Hybrid systems provide overpressure and filtered air in a vehicle; it also allows the personnel inside to wear a ventilated facepiece when the vehicle must be opened to the outside air. A total system combines the hybrid system with conditioned air, thus, reducing heat stress. Collective protection shelter (CPS) systems for HSS treatment facilities provide

filtered, conditioned air. These systems also have litter air locks for access to litter patients. Field Manual 3-4 provides additional information on collective protection systems.

(b) Because the gamma component in radiation contamination can easily penetrate clothing and tentage, radiation collective protection (fallout shelters) must also incorporate shielding. Shielding is best obtained by locating in deep cellars of high rise buildings, in tunnels, and in caves. In the open, radiation is received from all sides, and without scraping the ground of all particles, little protection is afforded by tentage. Appendix B provides methods of applying protective schemes. Engineer support is required for some applications.

(3) *Decontamination.* Avoidance and collective protection are not always options; therefore, decontamination is a method of lowering the unit's MOPP level. Decontamination restores the unit's effectiveness. How much is decontaminated depends on the tactical situation and the mission; the decontamination resources available; and the extent of unit contamination. Generally, decontaminate only what is needed to continue the mission. It must be remembered that decontamination is expensive in the resources needed: manpower, time, and materials. Therefore, consider the principles of speed, need, limit, and priority when planning for decontamination. See Appendix C for detailed guidance on patient decontamination; see FM 3-5 for detailed guidance on unit and equipment decontamination.

(a) Three types of decontamination can be used to reduce the effect of an NBC attack on unit effectiveness. They are basic skills, hasty decontamination operations, and deliberate decontamination operations. Basic skills decontamination is conducted using supplies and equipment carried by each individual or unit vehicle and are basic to soldier survival. Hasty decontamination operations are the actions of teams or squads using equipment found within battalion-size units. Deliberate decontamination requires a detailed plan; more manpower and resources are needed than in hasty decontamination.

(b) Unit decontamination must be conducted as soon as possible; contamination forces the unit to remain in higher MOPP levels, degrading unit effectiveness. However, only conduct hasty decontamination of personnel and mission-essential equipment; deliberate decontamination of everything will tax the units personnel and materiel resources. Decontaminate as far forward as possible to limit the spread of contamination; bring decontamination assets to the area, rather than moving contaminated personnel (except patients) and equipment away from their operational area. Lastly, decontaminate the most important things first. The commander decides which assets are more essential to the unit's mission.

(c) Besides decontaminating themselves and their equipment, the medical treatment personnel must also ensure that patients are decontaminated. See Appendix C for detailed patient decontamination procedures.

(4) *Radiation exposure. When* required to operate in a nuclear-contaminated area, personnel will be exposed to damaging radiation. Methods are established to estimate the dose and maintain these estimates for each platoon or section at higher headquarters. The radiation exposure of a unit determines its radiation exposure status (RES) and is outlined in Table 3-1 below. When the unit or section receives a mission which involves exposure to radiation, the commander assigns an operational exposure guide (OEG) to that mission. The OEG is the amount of total exposure he is willing to allow his troops to receive in completing the mission. The three levels of OEG are negligible risk, moderate risk, and emergency risk. Based upon the OEG of the mission and the RES of available units, the commander selects the unit to perform the mission, limiting personnel exposure to radiation.

Table 3-1. Radiation Exposure Status Categories

RES-O	The unit has had no radiation exposure.
RES-1	The unit has been exposed to greater than 0 cGy but less than or equal to 70 cGy.
RES-2	The unit has been exposed to greater than 70 cGy but less than or equal to 150 cGy.
RES-3	The unit has been exposed to greater than 150 cGy.

3-4. Movement/Management of Contaminated Facilities

Operations in a contaminated area require the commander to operate with contaminated or potentially contaminated assets. The commander must be aware that his primary mission is to conserve the fighting strength. The following provides guidance in determining how to operate with contaminated facilities.

a. Fulfill Health Service Support Principles. In making his decision to move or continue to operate with contaminated facilities, the commander must apply the principles of conformity, proximity, flexibility, mobility, continuity, and control. The facility's operation must conform with the tactical commander's operation plan (OPLAN). Health service support must be provided to the tactical unit as far forward (proximate) as possible; this ensures prompt, timely care. Additionally, the HSS commander must be flexible; he must tailor his support to the OPM requirements. Therefore, HSS assets must be as mobile as the unit they support; there must be continuity of HSS so that all units have support. Finally, the commander must control his assets. Dispersion on the integrated battlefield may enhance unit survivability; however, if the commander cannot maintain control of his assets, they become compromised.

b. Decision to Move. The commander (when deciding to move his unit to an uncontaminated area, or in support of the tactical commander's plan) must base his decision to move on several factors.

(1) *Protection available.* The commander must consider the type of protection available in the new area. Will he need to establish the units' CPS systems, or are indigenous shelters available (for example, buildings, tunnels, caves)? Does the unit have sufficient individual protective equipment for unit personnel and are there sufficient chemical agent patient protective wraps (PPW) to perform the anticipated mission?

(2) *Persistency.* If his unit has been in a contaminated area, is the contamination persistent or nonpersistent? Is the area he will move to contaminated or clean? Persistency determines the MOPP level; the degree of threat; and performance decrement to be expected because of the protective measures used.

(3) *Patients.* Before moving the entire facility, the commander must consider the number and types of injuries in his current patient load. Plans must be implemented to evacuate the patients who are currently on hand. These patients are stabilized before movement; however, evacuation assets must be called for.

(4) *Alternate facilities.* Alternate facilities may be used (if the facility can be configured to ensure continuity of care or provide a protected area for patients) until the relocating activity is up and operating.

(5) *Evacuation.* Consideration must always be given to the patient. Routes of evacuation must be disseminated. The ability to evacuate patients before a move and continue evacuating patients during the move must remain in effect. All evacuation considerations must be addressed before any move.

(6) *Mobility. A* facility that is not 100 percent mobile requires movement support. Thus, the commander must coordinate movement support requirements with higher headquarters.

(7) *Mission. The* primary consideration is the support mission of the MTF. The tactical commander requires HSS for his troops; when a move jeopardizes the quality of care, the move may be delayed.

(8) *Sustainability.* Hand-in-hand with the mission is sustainability (the ability of the unit to continue operating in support). If the current location compromises this ability, then the primary mission of the unit is in question. Similarly, if the move will result in a disruption of support, then the move may not be viable.

(9) *Decontamination.* When only a nonpersistent agent hazard exists and a CPS is not available, patients may be directed to another MTF until the hazard is gone; or certain facilities may be decontaminated, patient protection procedures applied, and the operation continued. A treatment facility contaminated with a persistent agent requires time-consuming and resource-intensive decontamination operations; it may include replacement of contaminated shelters. Hasty decontamination may be an alternative.

c. *Management of Contaminated and "Clean" Facilities.* Facilities contaminated with a persistent agent may be too resource intensive. Operating with a combination of contaminated assets and "clean" assets may be necessary. Mark contaminated assets with standard warning tags. Use these assets in contaminated environments and along contaminated routes. Keep clean assets in operation in clean areas. Of primary importance is proper marking and the avoidance of cross contamination. These two tenets, if followed, will ensure that support is continuous.

3-5. Leadership on the Nuclear, Biological, and Chemical Battlefield

Operating on the NBC battlefield will stress leadership. Beyond the normal stresses of combat, the NBC environment increases the need for good leadership. Heat stress from being in higher levels of MOPP for long periods of time may lead to dehydration; the commander must ensure that his troops rest, drink, and eat sufficiently to allow them to continue with the mission. In the midst of activity, rest, hydration, and nutrition are often overlooked; however, a good leader will ensure that his soldiers needs are met. In MOPP Level 4, severe dehydration and heat injury are likely. Individuals may suffer hyperventilation because of the enclosed feelings. Additionally, personnel remaining in MOPP Level 4 around the clock may suffer from increased sleep loss. Use of CPS can reduce this problem by allowing the troops to rest out of their MOPP gear. Because C^3 is hampered in MOPP Level 4, leaders must take actions to ensure that orders are received and that personnel perform their mission. Leaders must have response plans in place before NBC attacks occur. They must delegate responsibilities as much as possible. Leaders should concentrate on supervision, rather than on generation of procedures during and after an attack. Successful leaders are those who have planned well and need to do little during a crisis situation. The NBC battlefield will, therefore, require more dedicated leaders who can balance the needs of their troops and the mission. Successful leaders minimize the degradation of troop's effectiveness to meet the mission requirements.

This chapter implements STANAG 2866

CHAPTER 4

MEDICAL ASPECTS OF NUCLEAR, BIOLOGICAL, AND CHEMICAL WARFARE

Section I. NUCLEAR

4-1. General

With small yield tactical nuclear weapons, there will be comparatively large numbers of casualties from initial radiation, possibly combined with the blast effects. Burn injuries will be more common as the weapon yield increases. The types of injuries associated with nuclear warfare are—

a. Flash Injury. The intense light of a nuclear fireball can cause flash blindness. The duration of blindness depends upon the length of exposure and the light conditions. However, even at night it is unlikely that flash blindness will last more than a few minutes. Most individuals can continue their mission after the short recovery period. Severe cases may have retinal and optic nerve injuries that lead to permanent blindness; these cases will require evacuation to an MTF.

b. Blast *Injury.* As mentioned in Chapter 2, blast injuries consist of two types—

- Primary injuries due to overpressures such as ruptured eardrums and lungs.
- Secondary injuries such as lacerations and puncture wounds, as well as translational injuries from the severe winds.

c. Thermal Injury. Thermal injuries are generated by—

- Direct thermal radiation (flash burns and eye injuries).
- Indirect (flame) effects.

d. Radiation Injury. Casualties produced by ionizing radiation alone or with other injuries will be common. Radiation complicates treatment by its synergistic action. The short duration of field medical treatment limits the ability to determine the patient's total radiation exposure. Additionally, total exposure may not be received at one time, but as the result of several operations in contaminated regions. Table 4-1 summarizes radiation injuries and the effects of the radiation on the operational effectiveness of personnel.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
0-70	NONE TO SLIGHT INCIDENCE OF TRANSIENT HEADACHE AND NAUSEA. VOMITING IN UP TO 5% OF PERSONNEL IN UPPER PART OF DOSE RANGE.	6-12 HOURS	COMBAT EFFECTIVE	NONE	DUTY	MILD LYMPHOCYTE DEPRESSION WITHIN 48 HOURS AT UPPER END OF RANGE. MINIMAL OR NO SYMPTOMS.
70-150	TRANSIENT MILD NAUSEA AND VOMITING IN 5 TO 30% OF PERSONNEL.	2-24 HOURS	COMBAT EFFECTIVE	NONE	DUTY	MODERATE DROP IN LYMPHOCYTE, PLATE-LET, AND GRANULOCYTE COUNTS. INCREASED SUSCEPTIBILITY TO OPPORTUNISTIC PATHOGENS.
150-300	TRANSIENT MILD TO MODERATE NAUSEA AND VOMITING IN 20-70% OF PERSONNEL. MILD TO MODERATE FATIGABILITY AND WEAKNESS IN 25 TO 60% OF PERSONNEL.	2 HOURS-2 DAYS	DT:PD FROM 4 HOURS UNTIL RECOVERY UT:PD FROM 6 HOURS UNTIL 1 DAY AND 6 WEEKS UNTIL RECOVERY.	MEDICAL CARE MAY BE NEEDED (AT 3 TO 5 WEEKS) FOR 10 TO 50% OF PERSONNEL TO ATTEND TO INFECTION, BLEEDING, AND FEVER.	DUTY, LESS THAN 5% DEATHS AT LOW END OF EXPOSURE RANGE. AT HIGH END OF RANGE, DEATH MAY OCCUR IN UP TO 10% OF PERSONNEL.	IF THERE ARE MORE THAN 1.7×10^9 LYMPHOCYTES PER LITER 48 HOURS AFTER EXPOSURE, IT IS UNLIKELY THAT AN INDIVIDUAL HAS RECEIVED A FATAL DOSE.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel (Continued)

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
300-500	TRANSIENT MODERATE NAUSEA AND VOMITING FROM 50% TO 90% OF PERSONNEL. MODERATE FATIGABILITY IN 50% TO 90% OF PERSONNEL MOST LIKELY.	2 HOURS-3 DAYS	DT:PD FROM 3 HOURS UNTIL DEATH OR RECOVERY. UT:PD FROM 4 HOURS UNTIL 2 DAYS, AND FROM 2 WEEKS UNTIL DEATH OR RECOVERY.	AT 2-5 WEEKS FOR 10-60% OF PERSONNEL; INFECTION, BLEEDING, FEVER, ULCERATION, LOSS OF APPETITE AND DIARRHEA.	DUTY AT LOW END OF EXPOSURE RANGE, LESS THAN 10% DEATHS. AT HIGH END OF EXPOSURE RANGE DEATH MAY OCCUR IN MORE THAN 50% OF PERSONNEL.	MODERATE TO SEVERE DROP OF LYMPHOCYTES MODERATE DROP IN GRANULOCYTE AND PLATELET COUNTS. LOSS OF HAIR AFTER 14 DAYS. PURPURA AFTER ABOUT 3 WEEKS.
500-800	MODERATE TO SEVERE NAUSEA, VOMITING, FATIGABILITY, AND/OR WEAKNESS IN 80-100% OF PERSONNEL.	WITHIN THE FIRST HOUR	DT:PD FROM 1 HOUR UNTIL 3 WEEKS. CI FROM 3 WEEKS UNTIL DEATH. UT:PD FROM 2 HOURS TO 2 DAYS, AND 7 DAYS UNTIL 4 WEEKS. CI FROM 4 WEEKS UNTIL DEATH.	AT 10 DAYS TO 5 WEEKS FOR 50-100% OF PERSONNEL; INFECTION, BLEEDING, FEVER, LOSS OF APPETITE, ULCERATION, DIARRHEA, NAUSEA, VOMITING, FLUID AND ELECTROLYTE IMBALANCE, HYPOTENSION.	AT LOW END OF EXPOSURE RANGE DEATH MAY OCCUR IN MORE THAN 50% AT 6 WEEKS. AT HIGH END OF EXPOSURE RANGE, DEATHS MAY OCCUR IN 90% AT 3-5 WEEKS.	PRACTICALLY NO LYMPHOCYTES AFTER 2 DAYS. SEVERE DROP IN GRANULOCYTE AND PLATELET COUNTS LATER.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel (Continued)

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
800-3000+	SEVERE NAUSEA, VOMITING, FATIGABILITY, WEAKNESS, DIZZINESS AND DISORIENTATION. MODERATE TO SEVERE FLUID AND ELECTROLYTE IMBALANCE, POSSIBLE HIGH FEVER AND COLLAPSE.	WITHIN THE FIRST 3 MINS UNTIL DEATH.	DT:PD 45 MINS UNTIL 3 HOURS. CI 3 HOURS UNTIL DEATH. UT:PD 1 HOUR UNTIL 7 HOURS. CI 7 HOURS UNTIL DEATH.	3 MINS UNTIL DEATH.	1000 cGy: 100% DEATH AT 2-3 WEEKS.	BONE MARROW TOTALLY DEPLETED IN 2 DAYS.

NOTES:

1. DT — DEMANDING TASKS.
   UT — UNDEMANDING TASKS.
   PD — PERFORMANCE DEGRADED (25% TO 75% OF NORMAL PERFORMANCE).
   CI — COMBAT INEFFECTIVE (LESS THAN 25% OF NORMAL PERFORMANCE).
2. DOSES ARE MIDLINE TISSUE DOSES FREE IN AIR (WHOLE BODY DOSES).
3. THE LD 50/60 DAYS DOSE HAS BEEN ASSUMED TO BE ABOUT 450 cGy IN COMPILING THIS TABLE.
4. THE MORTALITY ESTIMATES ARE FOR UNTREATED, OTHERWISE FIT AND WELL-NOURISHED YOUNG ADULTS.
5. PERFORMANCE COULD BE FURTHER DEGRADED WHEN RADIATION IS COMBINED WITH THE WEARING OF IPE, CHEMOPROPHYLAXIS, OR OTHER STRESSOR.

4-2. Management of Nuclear Patients

a. Management. Management of soldiers injured from the immediate effects of nuclear weapons (flash, blast, thermal) are the same as for conventional battlefield injuries, although the injury severity may be increased. First aid (self-aid, buddy aid, and combat lifesaver [CLS]) for lacerations, broken bones, and burns are performed as prescribed in FM 21-11.

b. Mass Casualty. Amass casualty situation is developed by a nuclear attack; that is, the number of patients requiring care exceed the capabilities of treatment personnel and equipment. EXAMPLES: One combat medic has two patients requiring immediate lifesaving procedures; he can only provide needed procedures for one. Thus, correct triage and evacuation procedures are essential. Triage classifications for nuclear patients differ from conventional injured patients. Nuclear patient triage classifications are as follows:

- Immediate treatment group (T1). Those requiring immediate lifesaving surgery. Procedures should not be time-consuming and should concern only those with a high chance of survival, such as respiratory obstruction and accessible hemorrhage.

- Delayed treatment group (T2). Those needing surgery, but whose conditions permit delay without unduly endangering safety. Life-sustaining treatment such as intravenous fluids, antibiotics, splinting, catheterization, and relief of pain may be required in this group. Examples are fractured limbs, spinal injuries, and uncomplicated burns.

- Minimal treatment group (T3). Those with relatively minor injuries who can be helped by untrained personnel, or who can look after themselves, such as minor fractures or lacerations. Buddy care is particularly important in this situation.

- Expectant treatment group (T4). Those with serious or multiple injuries requiring intensive treatment, or with a poor chance of survival. These patients receive appropriate supportive treatment compatible with resources, which will include large doses of analgesics as applicable. Examples are severe head and spinal injuries, widespread burns, or high doses of radiation; this is a temporary category.

Table 4-2 provides radiation dosage, degradation of treatment, and treatment priorities for radiation and combined injuries.

Table 4-2. Radiation Dosage and Degradation of Treatment Priority

SERIAL	STARTING PRIORITY	FINAL PRIORITY		
		LESS THAN 150 cGy	150-550 cGy	OVER 550 cGy
1	RADIATION ONLY	DUTY OR T3	T3**	T4
2	T1	T1	T1 or T4*	T4
3	T2	T2	T2 or T4*	T4
4	T3	T3	T3**	T4
5	T4	T4	T4	T4

* Select T4 in the case of full or partial thickness burns covering more than 18 percent of the body surface, or trauma which would either result in significant infection or be categorized as severe but not immediately life threatening, such as a fractured femur. This is a clinical decision and not necessarily subjectively reproducible.

** Includes the probable requirements for antibiotics and transfusion at a later time. So this classification does not suggest that the patient is not in need of treatment, but rather that he does not need immediate specialized care.

4-3. Handling and Managing Radioactively Contaminated Patients

a. Radiologically Contaminated Patients. Soldiers from fallout areas may have fallout on their skin and clothing. Although the soldier will not be radioactive, he may suffer radiation injury from the contamination. Removal of the contamination should be accomplished as soon as possible; definitely before admission into a clean treatment area. The distinction must be made between a radiation injured soldier and one who is radiologically contaminated. Although soldiers may have received substantial radiation exposure, this exposure alone does not result in the individual being contaminated. Normally, contaminated soldiers do not pose a short-term hazard to the medical staff, rather the contamination is a hazard to the soldiers' health. However, without patient decontamination, medical personnel may receive sufficient exposure to create beta burns, especially with extended exposure.

b. Handling Radiologically Contaminated Patients. To properly handle radiologically contaminated soldiers, medical personnel must first detect the contamination. Two detectors, the AN/PDR27 and the AN/VDR2, are used to monitor patients for contamination. Generally, a reading on the meter twice the current background reading indicates that the patient is contaminated. Monitoring is conducted when potentially contaminated soldiers arrive at the MTF. This monitoring is conducted at the MTFs receiving point before admitting the patient. Contaminated patients must be decontaminated before admission.

c. Decontamination. Radioactive deco lamination is easy. Removing all outer clothing and a brief washing or brushing of exposed skin will reduce 99 percent of contamination; vigorous bathing or showering is unnecessary. Do not let radiological contamination interfere with immediate lifesaving treatment or the best possible medical care. See Appendix C for details on patient decontamination.

d. Treatment. Treatment procedures for radiation injuries are described in FM 8-9 and the NATO Handbook "Emergency War Surgery."

Section II. BIOLOGICAL

4-4. General

The impact of biological warfare on HSS may be a few patients with diarrhea, or a mass casualty situation. The first indication of a BW attack or use will most likely be patients arriving at an MTF with an illness. The routes of entry for BW agents are the same as endemic diseases (that is, through inhalation, ingestion, or percutaneous inoculation). Biological agents are most likely to be delivered covertly and by aerosol. Other routes of entry are thought to be less important than inhalation, but are nonetheless potentially significant.

a. Aerosol.

(1) *Inhalation.* Inhalation of agent aerosols, with resultant deposition of infectious or toxic particles within alveoli, provides a direct pathway to the systemic circulation. The natural process of breathing causes a continuing flux of biological agent to exposed individuals. The major risk is pulmonary retention of inhaled particles. Droplets as large as 20 microns can infect the upper respiratory tract; however, these relatively large particles generally are filtered by natural anatomic

and physiological processes, and only much smaller particles (ranging from 0.5 to 5 microns) reach the alveoli efficiently.

(2) *Ingestion.* Food and water supplies may be contaminated during an aerosol BW attack. Unwary consumption of such contaminated materials could result in disease.

(3) Percutaneous. Intact skin provides an excellent barrier for most, but not all, biological agents. However, mucous membranes and damaged skin constitute breaches in this normal barrier through which agents may readily pass.

b. Contamination of Food and Water. Direct contamination of food and water could be used as a means to disseminate infectious agents or toxins. This method of attack is most suitable for sabotage activities and might be used against limited targets such as water supplies or food supplies of a specific unit or base.

c. *Other Considerations.*

(1) Arthropod-borne. The spread of diseases by releasing infected arthropods such as mosquitoes, ticks, or fleas. These live vectors can be produced in large numbers and infected by allowing them to feed on infected animals, infected blood reservoirs, or artificially-produced sources of a BW agent.

(2) *Long-term survival of infectious agents.* Preservation of toxins for extended periods and the protective influence of dust particles onto which microorganisms adsorb when spread by aerosols have been documented. Therefore, the potential exists for the delayed generation of secondary aerosols from contaminated surfaces. To a lesser extent, particles may adhere to an individual or to clothing, creating additional exposure hazards.

(3) *Person-to-person. The* spread of potential biological agents by person-to-person has been documented. Man, as an unaware and highly effective carrier of a communicable agent, could readily become a source of dissemination (for example, plague or smallpox).

4-5. Management of Biological Warfare Patients

a. Management. Management of patients suffering fiom the effects of BW agents may include the need for isolation. Barrier nursing for patients suspected of suffering from exposure to BW agents will reduce the possibility of spreading the disease to health care providers and other patients. Specimens must be collected and submitted toi the designated supporting laboratory for identification.

b. Mass Casualty. A BW agent attack can produce a mass casualty situation at all echelons of HSS. A major problem with a BW mass casualty situation is that HSS personnel are more susceptible to becoming a casualty to BW agents. Also, the ill patient may be the first indicator that a BW agent has been dispersed.

c. Decontamination. Biologically contaminated patients require some degree of detail. Contamination can be removed by use of a diluted disinfectant solution, or a 0.5 percent chlorine solution. See Appendix C for details on patient decontamination.

d. Treatment. Specific treatment is dependent upon the BW agent used. Patients are treated for symptomatic presentation. Field Manuals 8-9 and 8-33 provide additional information on treatment.

Section III. CHEMICAL

4-6. General

Health service support operations in a CW environment will be complex. In addition to providing care in protected environments or while dressed in protective clothing, medical personnel will have to treat chemical injured and contaminated patients in large numbers. Types of injuries associated with chemical warfare are—

a. Nerve Agent Injury. Nerve agent injuries are classified as mild, moderate, and severe. Classification is based upon the signs and symptoms presented in the individual. The individual may only be having minor problems, or may be convulsing and exhibiting severe respiratory distress. Some individuals can return to duty after receiving a single injection of the Mark I; others may require multiple doses of the Mark I, CANA, and assisted ventilation.

b. Blister Agent Injury. Individuals exposed to blister agents may not know that they have been exposed to the agent for hours to days later. The first indication of exposure may be small blisters on the skin. Others will have immediate burning because of the high level of exposure. The individual with a few small blisters or reddening of the skin can continue the mission, An individual suffering mild injuries may require admission to a MTF for treatment, then returned to duty; whereas, the individual with severe injuries may have to be evacuated out of the theater.

c. Incapacitating Agent Injury. Incapacitating agents produce injury by depressing the CNS, or stimulating the CNS. These agents affect the CNS by disrupting the high integrative functions of memory, problem solving, attention, and comprehension. Relatively high doses produce toxic delirium which destroys the ability to perform any task.

d. Blood Agent Injury. Blood agents produce their effects by interfering with oxygen use at the cellular level. The agent prevents the oxidative process within cells. In high concentrations there is an increase in the depth of respiration within a few seconds. The patient cannot voluntarily hold his breath. Violent convulsions occur after 20 to 30 seconds with cessation of respiration within 1 minute. Cardiac failure follows within a few minutes. Inhalation is the usual route of entry.

e. Lung-Damaging Agent Injury. Lung-damaging (choking) agents attack lung tissue, primarily causing pulmonary edema. The principle agents in this group are phosgene, diphosgene, chlorine, and chloropicrin.

4-7. Management of Chemical Agent Patients

a. Management. Movement of chemical agent casualties can spread the contamination to clean areas. All casualties are decontaminated as far forward as the situation permits. All patients must be decontaminated before they are admitted into a clean MTF. The admission of one contaminated patient into an MTF will contaminate the facility; thereby, reducing treatment capabilities in the facility.

b. Mass Casualty. As with other NBC weapon/agent employment a mass casualty situation is presented when chemical agents are employed. Additional HSS personnel and equipment

must be provided in a short period of time if the level of care is to be maintained. Treatment at far forward MTFs is limited to life-or limb-saving care. Patients that can survive evacuation to the next echelon of care are not treated at the forward facility. This provides time for treating those patients that cannot survive the evacuation time.

c. Decontamination. Decontamination of chemically contaminated patients requires the removal of their contaminated clothing and the use of a variety of decontamination kits and solutions. See Appendix C for details on patient decontamination.

d. Treatment. Field Manual 8-285 provides treatment procedures for chemical agent patients.

CHAPTER 5

ECHELONS I AND II HEALTH SERVICE SUPPORT

5-1. General

a. On future battlefields, NBC warfare will be considered a condition of the battle. Therefore, Echelons I and II HSS personnel must prepare to support in these environments. The importance of first aid (self-aid, buddy aid, and CLS support) becomes even more critical. Staffing of HSS units is based upon the minimum required to provide support on a conventional battlefield. Thus, they will be taxed in their ability to provide the level of HSS that is available on the conventional battlefield.

b. Nuclear, biological, and chemical actions cause high casualty rates, materiel losses, obstacles to maneuver, and contamination. Mission-oriented protective posture (Levels 3 and 4) results in body heat buildup, reduces mobility, and degrades visual, touch, and hearing senses: ultimately, degrading unit effectiveness.

c. Contamination is a major problem in providing HSS in an NBC environment. To maximize the unit's survival and support role, HSS leaders must take action to avoid NBC contamination. Maximum use must be made of—

- Contamination avoidance.
- Alarm and detection equipment and unit dispersion.
- Overhead shelters, shielding materials, and protective, covers.
- Collective protection shelters.
- Chemical agent resistant coatings.

d. On the integrated battlefield, HSS is focused on keeping the soldier in the battle. Effective and efficient triage, emergency treatment, decontamination, and contamination control in the operational area saves lives, assures judicious evacuation, and maximizes the RTD rate.

5-2. Medical Planning Factors

a. To provide adequate HSS, definitive planning and coordination is required. This includes provisions for treatment, evacuation, and hospitalization (including care for enemy prisoners of war [EPW]). Field Manuals 8-9, 8-10-4,8-10-6, and 8-285 contain additional information for use in planning for HSS operations in an NBC environment. Higher headquarters must distribute timely plans and directives to subordinate units. Provisions for emergency medical care of civilians, consistent with the military situation, must be included.

b. The medical planner makes an appraisal to determine the expected patient load. Using triage and emergency medical treatment (EMT) decision matrices for managing patients in a contaminated environment improves proficiency of treatment. See Figure 5-1 for a sample decision matrix. T-raining medical personnel in the use of simple decision matrices should enhance their effectiveness and contribute to more fficient battlefield treatment. Prior training for designated nonmedical personnel in patient decontamination procedures will enhance their effectiveness in the overall patient care mission.

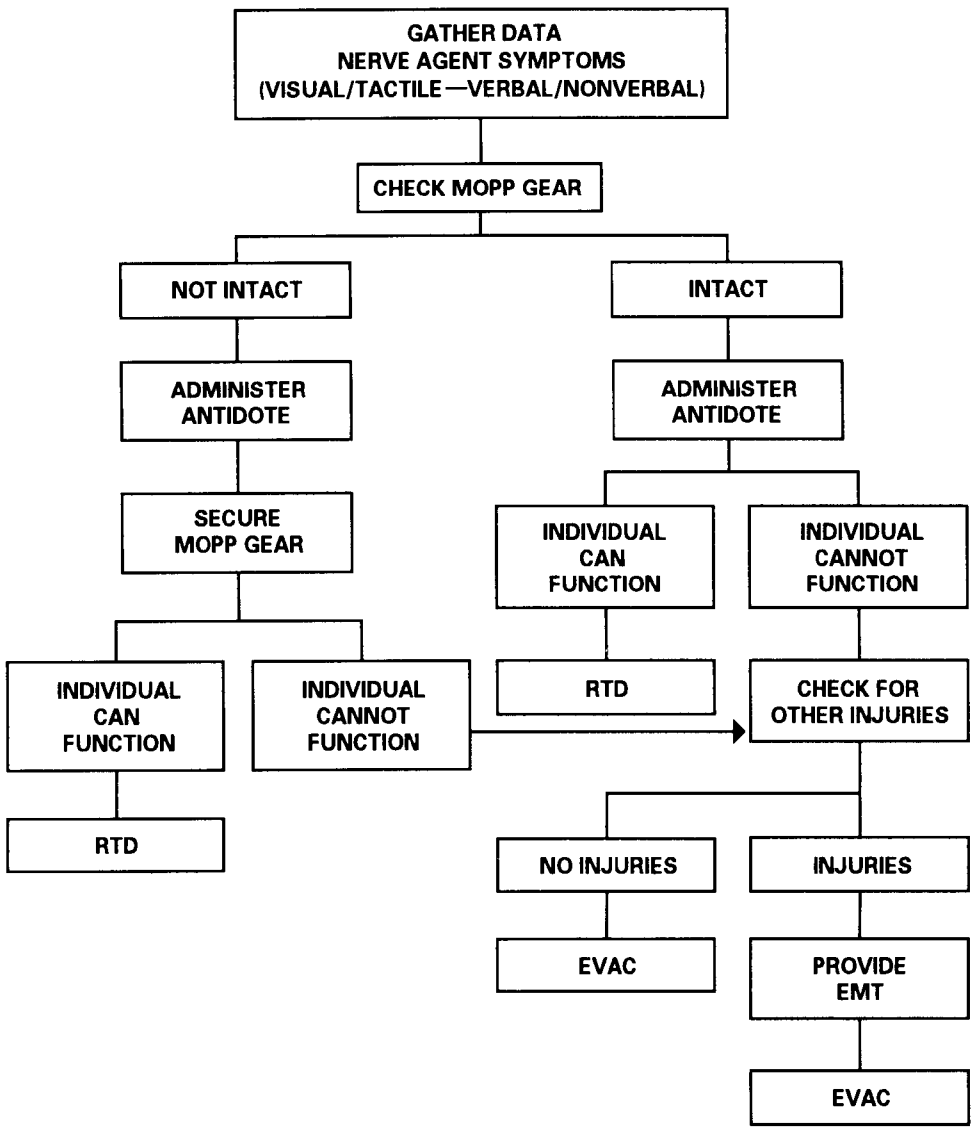

Figure 5-1. Sample triage and EMT decision matrix.

5-3. Unit Level Health Service Support

Unit-level HSS consist of combat medic, evacuation, and battilion aid station (BAS)operations.It is supported by first aid in the form of self-aid/buddy aid and the CLS. Commander and HSS planner must make provisions for clearing the battlefeild of casualties,including NBC casualties. Health services support personnel develop plans and are prepare in the event that NBC weapons or agentsareemployed.

5-4. Division-Level Health Service Support

a. In the brigade support area (BSA) HSS consists of evacuating patients from the BAS, providing area upport medical treatment, operating the BSA division clearing station (DCS),

including a patient holding capability for up to 40 patients for 72 hours, and providing limited dental service. The area support treatment team provides sick call and medical treatment for personnel in the BSA (on an area basis). The DCS continues care for patients received from the BAS; some are held up to 72 hours and then RTD; others require further stabilization before evacuation to a corps hospital. Patient holding provides a place where patients can recover from minor illnesses or injuries and RTD within a few hours. Limited laboratory, pharmacy, and radiology services are available. In an NBC environment, many patients may be suffering from claustrophobia or stress from being in confined areas, or in their MOPP. Many patients may RTD after a few hours of rest and refreshments. The DCS locates in a clean area, or establishes CPS to continue their HSS mission, including providing an area for patients to remove their MOPP for a few hours, then RTD. Preventive medicine (PVNTMED) and mental health personnel may be attached to the BSA medical company from the division support area (DSA) medical company to provide limited services within their specialties.

b. In the DSA, HSS consists of limited patient evacuation from the forward MTFs; provides patient evacuation on an area basis; provides area support medical treatment; operates the DSADCS (including a patient-holding capability for up to 40 patients for 72 hours); provides limited laboratory, pharmacy, radiology, and dental services, PVNTMED support, limited optometry service, and mental health support. The PVNTMED team provides limited support in the areas of disease vector surveillance, water quality control (including NBC contamination surveillance), and communicable diseases control. The mental health personnel provides counseling and comfort for combat stress patients; these patients are returned to duty as far forward as their condition permits.

5-5. Actions Before a Nuclear, Biological, or Chemical Attack

The first and foremost action for medical personnel to take before an NBC attack is training to survive the attack; operate the MTF in the environment; and effectively care for NBC casualties. Medical personnel must keep their immunizations current; use available prophylaxis against suspect agents; use pretreatments for suspect agents; and have antidotes and essential medical supplies readily available for known or suspected chemical or biological agents. The best defense for medical personnel is to protect themselves, their patients, medical supplies, and equipment by applying contamination avoidance procedures. They must ensure that stored medical supplies and equipment are in protected areas, or in their storage containers with covers in place. One method of having supplies and equipment protected is to keep them in their shipping containers until actually needed. When time permits and warnings are received that an NBC attack is imminent, or that a downwind hazard exists, medical personnel should seek protected areas such as CPS, basements of buildings, culverts, and ravines for themselves and their patients.

5-6. Actions During a Nuclear, Biological, or Chemical Attack

Medical personnel and their patients will remain in the best available protected areas during the attack. During a nuclear attack, they take up positions within the shelter that are away from windows and other openings; they only move out of these positions when notified that it is safe to do so. In the absence of higher authority, medical personnel use caution in their movements.

5-7. Actions After a Nuclear, Biological, or Chemical Attack

Medical personnel must survey their equipment to determine the extent of damage and their capabilities to continue the mission. Initially, patients from nuclear detonations will be suffering

thermal burns or blast injuries. Also, expect disorientation from patients and medical personnel. Normally, radiation-induced injuries will be observed after a few hours to days. Chemical agent patients will manifest their injuries immediately upon exposure to the agent, except for blister agents. Biological agent patients may not show any signs of illness for hours to days after exposure. Alll patients receiving treatment must be checked for NBC contamination. Patients are decontaminated before treatment to reduce the hazard to medical personnel, unless life- or limb-threatening conditions exist. Patients requiring treatment before decontamination are treated in the EMT area of the decontamination station. Examples of patient conditions that may require treatment at the cotaminated treatment station of the decontamination area are—

- Cardiac arrest.
- Massive hemorrhage.
- Respiratory distress.

5-8. Logistical Considerations

a. The HSS system is organized and equipped to provide support in a conventional environment. However, it must train and prepare to operate in all battlefield situations. Operating in an NBC environment requires the issue of chemical patient treatment sets, chemical patient decontamnination sets, and CPS systems when not used as the primary shelter in conventional operations. For operational procedures and use of the CPS as an MTF and management of patients, see Appendix D and the appropriate technical manual for the specific CPS system.

b. The medical supply office (DMSO) maintains a 5 to 15-day stockage level of Class VIII supplies; the exact number of days of supplies maintained are prescribed in the TSOP. Medical supplies and equipment are protected from contamination by chemical agent resistant coatings or protective coverings. Class VIII stocks are dispersed to prevent or reduce damage and NBC contamination. Health service support plans include protecting (NBC hardening) contingency stocks and rapid resupply of affected units by using prepackaged and preconfigured push resupply. Other resupply procedures may be established by the command in the TSOP. Decontaminate items before issue to using units.

c. The divisional and nondivisional medical company PVNTMED section and supporting corps PVNTMED personnel are responsible for testing the quality of water for the division. Water from local sources (lakes, ponds, wells, or public water systems) maybe contaminated; therefore, test all sources for contaminants before use; frequently retest the water. Mark contaminated water sources with NBC contamination markers; do not use the water until it is safe, or water treatment equipment capable of removing the contaminants is employed. Dispose of contaminated water in a manner that prevents secondary contamination; mark the area. Frequently monitor all water dispensing and associated equipment for possible contamination. Water supply on the NBC battlefield is provided on an area basis by the supply and transportation battalion. However, maneuver elements receive their water supply through unit distribution.

5-9. Personnel Considerations

During NBC actions, medical treatment requirements will increase; thus, medical reinforcement replacement may be necessary. Plans for HSS following an NBC attack must include efforts to

conserve available HSS personnel and ensure their best use. Medical personnel will be fully active in providing EMT or advanced trauma management (ATM); they will provide more definitive treatment as time and resources permit. However, to provide definitive care they must be able to work in a shirt sleeved environment, not in MOPP Levels 3 or 4. Nonmedical personnel conduct search and rescue operations for the injured or wounded; they provide immediate first aid and decontamination. Also, noonmedical personnel are required to man the patient decontamination station at the BAS and DCS (FMs 3-5, 8-10-4, and 8-285).

5-10. Disposition of Treatment Elements

Select sites for the BAS and DCS that are located away from likely target areas. Covered and concealed sites are extremely important; they increase protection for operating the MTF.

a. Operating CPS systems at the BAS requires more than four medical personnel. This is why the squad does not operate as split teams during NBC operations. A method of obtaining additional HSS in the area of operations (AO) is to request additional medical teams from the supporting medical company.

b. The BAS is equipped with two medical equipment sets (MES) for chemical agent patient treatment and one MES for chemical agent patient decontamination. These sets have enough consumable supplies for decontamination and treatment of 60 chemical agent patients. These sets are also used at DCS, corps hospitals, and COMMZ hospitals to decontaminate and treat chemical agent patients. The number of sets varies, depending on the treatment site.

NOTE

The chlorine granules in the chemical agent patient decontamination set are used to prepare the chlorine solution to decontaminate patients.

5-11. Civilian Casualties

Civilian casualties may become a problem in populated or built-up areas; they may not have protective equipment and training. The BAS and DCS may be required to provide assistance when civilian medical resources cannot handle the work load. However, aid to civilians will not be undertaken at the expense of health services for US personnel. Keep in mind that once care for civilians has begun, you are required to continue this care until relieved.

5-12. Nuclear Environment

a. The medical platoon must continue its support mission in a nuclear environment. To continue their support role, they must prepare protective shelters. Well-constructed foxholes with overhead cover and expedient shelters (reinforced concrete structures, basements, railroad tunnels, or trenches) provide good protection from nuclear attacks (see Appendix B). Armored vehicles also provide protection against both the blast and radiation effects of nuclear weapons. Casualties generated in a nuclear attack will likely suffer multiple injuries (combination of blast, thermal, and radiation injuries) which will complicate HSS. Nuclear radiation casualties fall into three categories:

- The irradiated casualty is one who has been exposed to ionizing radiation, but is not contaminated. They are not radioactive and pose no radiation threat to medical care providers. Casualties who have suffered exposure to initial nuclear radiation will fit into this category.

- The externally contaminated casualty has radioactive dust and debris on his clothing, skin, or hair. He presents a "housekeeping" problem to the MTF, similar to the lice-infested patient arriving at a peacetime MTF. However, this contamination may present a threat to medical personnel. The externally contaminated casualty is decontaminated at the earliest time consistent with required medical care. Lifesaving care is always rendered, when necessary, before decontamination.

- The internally contaminated casualty is one that has ingested or inhaled radioactive materials, or radioactive material has entered the body through an open wound. The radioactive material continues to irradiate the casualty internally until radioactive decay and biological elimination removes the radioactive isotope. Attending medical personnel are shielded, to some degree, by the patient's body. Inhalation, ingestion, or injection of quantities of radioactive material sufficient to present a threat to medical care providers is highly unlikely.

b. Medical units operating in a radiation fallout environment will face three problems:

- Immersion of the treatment facility in fallout, requiring decontamination efforts.
- Casualty production due to gamma radiation.
- Hindrance to evacuation caused by the contaminated environment.

5-13. Medical Triage

Medical triage, as discussed earlier, is the classification of patients according to the type and seriousness of injury. This achieves the most orderly, timely, and efficient use of medical resources. However, the triage process of nuclear patients is different than conventional injuries. See paragraph 4-2 for the triage classifications and Table 4-2 for the effects of radiation on triage.

5-14. Biological Environment

a. A biological attack (such as the enemy use of bomblets, rockets, spray or aerosol dispersal, release of arthropod vectors, and terrorist or insurgent contamination of food and water) may be difficult to recognize because frequently it does not have an immediate affect on exposed personnel. Medical personnel must monitor for biological warfare indicators such as—

- Increases in disease incidence or fatality rates.
- Sudden presentation of an exotic disease.
- Other sequential epidemiological events, especially when presented in lines of communication.

b. Passive defensive measures (such as immunizations, good personal hygiene, physical conditioning, using arthropod repellents, wearing protective mask, and practicing good sanitation) will mitigate the effects of most biological intrusions.

c. The medical commander must enforce contamination control to prevent injury to medical personnel and to preserve his facility. Incoming vehicles and patients must be surveyed for contamination. Ventilation systems in medical treatment facilities (without CPS) must be turned off if biological or chemical exposure is imminent.

d. Decontamination of most biologically contaminated patients and equipment can be accomplished with soap and water. See Appendix C for specific patient decontamination procedures.

e. Treatment of biological-agent patients may require observing and evaluating the individual to determine necessary medications, isolation, or treatment.

5-15. Chemical Environment

a. Handling chemically contaminated patients presents a great challenge to HSS units. All casualties generated in a chemical environment are presumed to be contaminated. Due to the vapor hazard associated with contaminated patients, medical personnel may have to remain at MOPP Level 4 for long periods of time. Therefore, they must locate clean areas in which to set up their MTF. When clean areas are not available, the CPS systems are established. However, the MTF only operates in a contaminated environment until they have the time and the means to move to a clean area.

b. A patient decontamination station is established to handle contaminated patients; see Appendix C. The station is separated from the clean treatment area by a "hotline" and is located downwind of the clean treatment area. Personnel on both sides of the "hotline" assume a MOPP level commensurate with the threat agent employed (normally MOPP Level 4). The patient decontamination station should be established in a contamination-free area of the battlefield. When CPS systems are not available, the clean treatment area is located upwind 30 to 50 meters of the contaminated work area. When personnel in the clean working area are away from the hotline, they may reduce their MOPP level. Chemical monitoring equipment must be used on the clean side of the hotline to detect vapor hazards due to slight shifts in wind currents; if vapors invade the clean work area, medical personnel must remask to prevent low-level chemical agent exposure and minimize clinical effects (such as miosis).

c. Initial triage, EMT, and decontamination are accomplished on the "dirty" side of the hotline. Life-sustaining care is rendered, as required, without regard to contamination. Normally, the senior EMT noncommissioned officer (NCO) performs initial triage and EMT at the BAS. Secondary triage, ATM, and patient disposition are accomplished on the clean side of the hotline. When treatment must be provided in a contaminated environment outside the CPS, the level of care may be greatly reduced because treaters and patients are in MOPP Level 3 or 4. However, lifesaving procedures must be accomplished.

d. The BAS and DCS will require 8 nonmedical augmentation personnel to perform patient decontamination. This augmentation must come from the supported units. See Appendix C for operating a patient decontamination station.

5-16. Operations in Extreme Environments

Enemy employment of NBC weapons in the extremes of climate or terrain warrants additional consideration. Included are the peculiarities of urban terrain, mountain, snow and extreme cold,

jungle, and desert operations in an NBC environment with the resultant NBC-related effects upon medical treatment and evacuation. For a more detailed discussion on NBC aspects of urban terrain, mountain, snow and extreme cold, jungle, and desert operations, see FM 31-71, FM 90-3, FM 90-5, FM 90-6, FM 90-10, and FM 90-10-1.

a. In mountain operations, units may be widely dispersed. Close terrain may limit concentrations of troops and fewer targets may exist; therefore, a lower patient load may be anticipated. Logistical problems, including medical evacuation, will increase. Health service support resources are spread over a wider area. Mountain passes and gorges may tend to canalize nuclear blast and the movement of chemical and biological agents. Ridges and steep slopes may offer some shielding from thermal radiation effects. Roads and railways may be nonexistent or of limited use, thus restricting movement and complicating patient evacuation. There will be a greater reliance on air ambulance support; however, the weather may hinder flights to some areas.

b. The effects of extreme cold weather combined with NBC-produced injuries have not been extensively studied. However, with traumatic injuries, cold hastens the progress of shock, providing a less favorable prognosis. Thermal effects will tend to be reinforced by reflection of thermal radiation from snow and ice-covered areas. Care must be exercised when moving chemically contaminated patients into a warm shelter. A chemical agent on the patient's clothing may not be apparent. As the clothing warms to room temperature, the chemical agent will vaporize (off-gas); thus, contaminating the shelter.

c. In rain forests and other jungle environments, the overhead canopy will to some extent shield personnel from thermal radiation. It may ignite, however, creating the danger of forest fires and resulting in burn injuries. By reducing sunlight, the canopy may increase the persistency effect of chemical agents near ground level. The canopy also provides a favorable environment for biological agents.

d. In desert operations, troops may be widely dispersed, thus, presenting less profitable targets. However, the lack of cover and concealment exposes troops to increased hazards. Smooth sand is a good reflector of both thermal and blast effects; therefore, these effects will generate an increase in injuries. High desert temperatures will increase the discomfort and debilitation of soldiers wearing MOPP; especially heat injuries.

5-17. Medical Evacuation in a Nuclear, Biological, and Chemical Environment

a. An NBC environment forces the unit commander to consider to what extent he will commit evacuation assets to the contaminated area. If the battalion or task force is operating in a contaminated area, most or all of the medical platoon evacuation assets will operate there. However, efforts should be made to keep some ambulances free of contamination.

b. We have three basic modes of evacuating casualties (personnel, ground vehicles, and aircraft). Using personnel to physically carry the casualties involves a great deal of inherent stress. Cumbersome MOPP gear, added to climate, increased work loads, and the fatigue of battle, will greatly reduce personnel effectiveness. If evacuation personnel are to be sent into a radiologically contaminated area, an OEG must be established; see Table 3-1. Radiation exposure records must be maintained by the NBC NCO and made available to the commander, staff, and medical platoon leader. Based on the OEG, the commander or medical platoon leader will decide which evacuation

elements to send into the contaminated area. Again, every effort is made to limit the number of evacuation assets which are contaminated. Evacuation considerations should include the following:

(1) A number of ambulances will become contaminated in the course of battle. Optimize the use of resources; use those already contaminated (medical or nonmedical) before employing uncontaminated resources.

(2) Once a vehicle or aircraft has entered a contaminated area, it is highly unlikely that it can be spared long enough to undergo a complete decontamination. This will depend upon the contaminant, the tempo of the battle, and the resources available to the evacuation unit. Normally, contaminated vehicles (air and ground) will be confined to dirty environments.

(3) Use ground ambulances instead of air ambulances in contaminated areas; they are more plentiful, are easier to decontaminate, and are easier to replace. However, this does not preclude the use of aircraft.

(4) The relative positions of the contaminated area, forward line of own troops (FLOT), and threat air defense systems will determine where helicopters may be used in the evacuation process. One or more helicopters may be restricted to contaminated areas; use ground vehicles to cross the line separating clean and contaminated areas. The ground ambulance proceeds to an MTF with a patient decontamination station; the patient is decontaminated and treated. If further evacuation is required, a clean ground or air ambulance is used. The routes used by ground vehicles to cross between contaminated and clean areas are considered dirty routes and should not be crossed by clean vehicles. Consider the effects of wind and time upon the contaminants; some agents will remain for extended periods of time.

(5) Always keep the rotorwash of the helicopters in mind when evacuating patients, especially in a contaminated environment. The intense winds will disturb the contaminants and further aggravate the condition. The aircraft must be allowed to land and reduce to flat pitch before patients are brought near. This will reduce the effects of the rotorwash. Additionally, a helicopter must not land too close to a decontamination station (especially upwind) because any trace of contaminants in the rotorwash will compromise the decontamination procedure.

c. Hasty decontamination of aircraft and ground vehicles is accomplished to minimize crew exposure. Units include deliberate decontamination procedures in their standing operating procedures (SOP). A sample aircraft decontamination station that may be tailored to a unit's needs is provided in FM 1-102 and FM 3-5.

d. Evacuation of patients must continue, even in an NBC environment. The medical leader must recognize the constraints NBC places on operations; then plan and train to overcome these deficiencies.

NOTE

The key to mission success is detailed preplanning. A health service support plan (HSSPLAN) must be prepared for each support mission. Ensure that the HSSPLAN is in concert with the tactical plan. Use the plan as a starting point and improve on it while providing HSS.

CHAPTER 6

HOSPITALIZATION

6-1. General

Many factors must be considered when planning for hospitalization on the integrated battlefield. The hospital staff must be able to defend against a Level 1 threat and survive NBC strikes while continuing their mission. Level 1 threats include sabotage and associated threats by individuals or small groups (two or three) of infiltrators. This threat may include the introduction of chemical or biological agents to the hospital area, the water supply, or food supplies; the destruction of equipment and/or supplies; and gathering intelligence information. On the larger scale of surviving NBC strikes and continuing to support the mission, operating in a contaminated environment will present many problems for hospital personnel. The use of NBC weapons or systems will create large numbers of casualties in short periods; compromise both the quality and quantity of health care delivered by posing a serious contamination threat to medical personnel; constrain mobility and evacuation; and contaminate the logistical supply base. These factors have the potential of severely degrading health care delivery. In the delivery of hospital support, consider the following assumptions:

a. Although health care facilities are not targeted, their location close to other combat support (CS) and combat service support assets make them vulnerable to NBC strikes for several reasons—

- The use of persistent chemical agents, high yield nuclear weapons, or biological agents in these areas is highly likely.

- Delivery systems for these weapons are characterized by poor accuracy and wide area coverage. Chemical and biological agents may present a hazard some distance downwind from the area of attack; also, residual radiation may extend for hundreds of kilometers from ground zero.

- The large size of hospital units, 12 acres or more, makes them extremely vulnerable to intentional or accidental targeting.

- Hospitals located near road networks and airfields for access to evacuation increases their exposure to tactical strikes of NBC weapons.

- There are ever increasing numbers of countries and individuals with the ability to manufacture and delivery NBC weapons/agents. This activity increases their use potential at all levels of conflict.

b. Large numbers of casualties are produced in a short period of time. Many of these casualties may have injuries that are unfamiliar to hospital personnel. These injuries may include—

- Heat stress casualties due to the use of MOPP Level 4 for extended periods.

- Psychological stress casualties due to isolation in MOPP and the impact of the NBC weapons. (Twenty-five percent of casualties may be in this category.)

- Chemical casualties.

- Chemical agent antidote overdose casualties.

- Biological casualties.

- Radiation casualties.
- Combined conventional and NBC injuries.

c. In addition to the wounding effects of NBC weapons on troops, their use will have other effects upon the delivery of patient care.

- Treatment may have to be delayed due to the need for decontamination.
- The arrival of contaminated patients at the hospital will require hospital personnel to perform triage; administer EMT procedures in the patient decontamination area; supervise augmentation personnel performing patient decontamination; and constantly monitor the hospital for contamination. A 20-man table of organization and equipment (TOE) augmentation team or 20 personnel from units within the geographic area/base cluster of the hospital will be required for patient decontamination. Augmentation personnel will operate in 4-man teams. See Appendix C for patient decontamination procedures.
- Patients may have been triaged at a lower HSS echelon. However, due to contamination or the mass casualty situation, triage must be performed for all patients as they arrive at the hospital. Triage ensures patients receive life- or limb-saving care in a timely manner.
- Conditions may mandate the use of nonmedical vehicles to evacuate patients. The use of these vehicles may limit en route medical care and complicate patient unloading procedures, but may be the only way to clear the battlefield and ensure timely care of patients at the hospital.
- Mission-oriented protective posture reduces the efficiency of all personnel:
  - Fine motor skills—wearing gloves reduces the ability to grasp and manipulate small items.
  - Gross motor skills—MOPP impedes the ability to move about.
  - Visual skills—the mask reduces visual fields and acuity,
  - Auditory skills—the mask and hood greatly reduces vocalization and hearing abilities.
  - Stamina—MOPP creates significant heat and mental stress. Heat injuries can occur in a very short period of time.
- At MOPP Level 3 or 4, all but the most basic patient care procedures have to be suspended.

d. Without CPS systems, hospitals may operate for a limited time in a nonpersistent agent environment, but are incapable of operating in a persistent agent environment.

- Chemical/biological filters for fixed site hospital ventilation systems will be a critical item of supply.
- Liquid chemical agents can penetrate either the TEMPER in about six hours, or the GP tentage in a shorter period of time. These agents will penetrate the wrappings on sterilized

equipment and supplies, medical supplies, and medications/solutions. They can also contaminate water/food supplies.

- Without a CPS system, treatment procedures involving an open wound or the respiratory tract in the presence of a chemical or biological agent hazard is limited. Exposing open wounds and the respiratory tract to the agent increases the effects of these agents on the patient.

- Without hardened protection, the hospital, staff, and patients are susceptible to the blast, heat, and missiling effects of nuclear weapons.

- Hospital biomedical equipment is vulnerable to the effects of the EMP produced by nuclear weapons. The EMP is not harmful to humans, animals, or plants, but is very damaging to electronic equipment.

- It is very difficult to decontaminate most hospital equipment. Decontamination may only be possible by aging (allowing the agent to off-gas).

- Hospitals are not kept in reserve. All personnel and equipment losses due to contamination or radiation will have to be replaced by out-of-theater resources.

6-2. Protection

a. Protection of hospital assets requires intensive use of intelligence data and careful planning. The limited mobility of hospitals (except the mobile army surgical hospital) makes their site selection vital to minimize collateral damage from attacks on other units.

(1) Hospitals must be located as close to the combat troops as possible to provide responsive care in support of the tactical commander's plan. However, their limited mobility and a lack of CPS systems must be considered when selecting their locations.

(2) Protective factors (distance from other CS/CSS units and interposed terrain features) must be balanced against the operational factors (accessibility and time required for patient transport).

(3) Regardless of the weapon systems used, relatively large portions of any tactical area will remain uncontaminated. Hospitals should avoid movement through or operation in contaminated areas.

b. Many defensive measures will either impede or preclude performance of the hospital mission. Successful hospital defense operations against an NBC threat is dependent upon accurate, timely receipt of information via the NBC 3 report. This warning data will allow hospital units to operate longer without the limitations and problems associated with MOPP use, then adopt a defensive posture when absolutely necessary. The detailed information on the areas affected and the types of agents used (provided in the NBC 5 and 6 reports respectively) allows the hospital staff to—

- Project the number and types of patients to be expected.

- Establish a patient decontamination area.

- Request patient decontamination assistance.

(1) Protective procedures.

(a) Because most hospital sections operate in sheltered areas (tentage or metal shelter), some protection is provided against vapor, liquid, and particulate (fallout) hazards. Locating equipment, such as trucks, under trees or other cover provides similar effects. Setting up hospitals in existing structures (concrete or steel buildings) will provide the maximum protection from hazards and eliminate many decontamination problems.

(b) Concealment and good operation security (OPSEC) will help prevent identification of a unit. Camouflaging the hospital may add to the NBC protection, but this effect must be weighed against the loss of Geneva Conventions protection.

(c) Dispersion is a defensive measure employed by tactical commanders; however, hospital operations limit the value of this technique. One technique that may be used is locating sections of the hospital, such as the motor pool, personnel billets, laundry, and logistical storage, further from the hospital complex than normal. This would increase dispersion without severely compromising the hospital mission.

(d) The MOPP does not protect against all effects of radiation from nuclear weapons. However, it provides some protection in preventing beta burns. By covering all body surfaces, especially hairy areas, MOPP greatly expedites the decontamination process.

(2) *Nuclear.*

(a) Most protective measures against nuclear attack require engineer and/lor intensive logistic support. This support includes placing sandbag walls around tents; digging trenches for patient occupation; or constructing earthen berms. Occupying existing structures, depending upon their strength and potential flammability, may be the best protection against the effects of a nuclear strike. The remainder of this section presents a variety of factors to be considered when selecting the protective posture for the hospital. Leaving equipment packed and loaded until actually needed for operations will help protect materiel in an NBC environment.

(b) Personnel and patient protection requirements will depend upon the threat. Is it fallout or the direct effects of the detonation?

• If the threat is nuclear fallout, the hospital structure provides protection; the fallout can be brushed or washed off. This allows protection while permitting patient care to continue virtually uninterrupted. A need to relocate the hospital will depend upon the degree of contamination; the amount of decontamination possible; and the projected stay before a normal move in support of tactical operations.

• Hospital tentage alone offers little protection against blast and missiling effects. If the patients are to remain in the tents, they are placed on the floor. Place all equipment on the ground or as low as possible, and secure all loose objects. In GP tents, sandbags can be piled around the base of the tent poles to add stability. The tent poles and patient beds should keep the canvas off the ground enough (if the tent collapses) to continue minimal patient care and evacuation; however, be aware of possible tent pole breakage.

• Hospital units are very susceptible to the thermal effect of a nuclear detonation. Tents will not provide protection against the thermal pulse. If the thermal effect (fires)

is an impending threat, patients and personnel in tentage must move to trenches or other nonflammable areas.

(3) Biological. The most likely use of a biological agent (such as anthrax) is spreading the agent by the pneumonic or airborne route. While such agents may produce large numbers of casualties, initially patients will be seen at the MTF in ones and twos. When a trend is identified, the use of a biological agent will be suspected. General protective measures are the same as for any infectious disease; specific protective measures are used once the vector or method of transmission has been identified. Designating a single hospital to care for these patients (from a patient care or disease transmission standpoint) may not be necessary. However, if there area limited number of cases, consolidating them all at one facility maximizes the use of limited diagnostic laboratory and personnel assets. Biological attack protective measures are the same as those for chemical agents when bombs, sprays, or gases are used. The difficulty in rapidly identifying biological agents may force the use of higher levels of MOPP for longer periods of time. Faced with this situation, a careful evaluation of the mask-only posture is necessary before implementing any level of MOPP.

(4) Chemical.

(a) Individual protection. When CPS systems are not available, using the correct MOPP level is essential in hospital mission performance. The level of MOPP assumed depends upon the level of threat. When employing MOPP, the following facts must be considered:

- MOPP 0. At this level, the mask must be carried and all other MOPP gear readily available. Because of space constraints in the hospital, even this level may hinder performance of tasks and increase the probability of accidents. Hospital personnel must ensure that patient's masks are available at their bedside. (For further information on patient protection, refer to (c) below.)

- MOPP 1. Overgarment worn. Since most hospital personnel remain in the same general area while performing their duties, all other MOPP equipment need not be carried, but must be readily available. The major consideration at this level is the addition of the heat stress factor.

- MOPP 2. Addition of the overboots will result in increased chances of falls. The overboots may catch on items around the patient's bed or other hospital equipment, causing personnel to trip and fall.

- MOPP 3. This level will severely alter the proficiency of all hospitalization personnel (decreased visual fields and acuity and reduced communication abilities while wearing the protective mask). The vapor hazard may limit surgery or other procedures which expose circulatory or respiratory systems to the open air.

- MOPP 4. The addition of the protective gloves further limits the procedures that can be performed. At this level, clinical patient care will essentially be reduced to first aid level.

- An alternative approach for the hospital commander is the use of the mask-only posture. This posture is acceptable when the hazard is from vapor only (except mustard). Patients and personnel intents and expandable shelters are protected from solid or liquid contamination (transfer hazards for a limited time). Personnel can work much more efficiently and for longer periods with mask-only posture instead of MOPP Level 3 or 4. However, the commander must weigh these

factors against the potential contamination transfer risk. This risk should be small, except in areas where patients or materiel are received from the outside. Individuals returning to, or bringing materiel from the outside must be extremely careful not to bring contamination into the mask-only ar ea. When considering this alternative, remember that, except those patients in PPW, the patients must also be at mask-only posture.

• The hospital must have a warning system that alerts all personnel of impending or present hazards. This system must include visual and auditory signals; the signals must operate inside and outside the hospital complex. There are numerous problems associated with warning personnel; they include—

- The wide area covered by the hospital operations.
- Some personnel will be asleep at all times of the day or night.
- The considerable noise from the power generation and environmental control equipment.
- Tentage and equipment which interrupts the line of sight.

• When the NBC alarm is activated, all personnel (including off duty personnel) report to their duty stations as soon as they are in MOPP. This allows for 100 percent personnel accounting and provides additional personnel to secure patients and materiel.

• With all openings secured and the ventilation system turned off, the hospital is at its best posture. For nonpersistent agents (vapor hazards), personnel and patients stay at the designated MOPP level until the all clear signal is given; then normal operations are resumed.

NOTE

Patients with injuries that prevent them from assuming a protective posture must be evacuated immediately to a clean treatment facility.

(b) Environmental protection. As noted previously, hospital complexes offer some protection against liquid or fallout contamination, but little against vapor hazards.

- When MOPP Level 1 posture must be assumed, close and secure all tent flaps. vents, and doors to prevent, the entrance of liquids or particles. All hospital personnel outside of shelters assumie MOPP Level 4. Cover or move all equipment and supplies into shelters (tents and trees), if possible. The best policy is to keep all equipment and supplies not immediately needed covered or in closed containers.

• When MOPP Level 3 or mask-only posture is assumed, shut down the hospitals ventilation system to prevent drawing vapors or fallout contamination into the hospital. This measure also provides some protection of the internal environment during the time required for the vapor to penetrate the tentage.

(c) Patient protection.

• Patient protection depends upon prior planning and timely warning of the chemical threat. Each patient's protective mask must be available and serviceable. If the patient came from a contaminated area, the mask must be decontaminated and the filters changed. The mask decontamination and filter change may have to be performed by hospital personnel. If ambulatory patients' medical conditions permit, they may be able to perform this task. Check all masks for serviceability as soon as the mission permits, but always before they are needed. Do not wait until the warning has been received to begin checking the mask. Each area must have an established plan for operations (to include assisting patients assuming MOPP or other protective posture) in the NBC environment. Appendix D provides additional information on patient protection.

CAUTION

Remember, personnel must be protected from exposure to the chemical agent on the mask; they assume MOPP Level 4 before beginning any decontamination process.

• Hospital staff always mask themselves first, then assist patients in masking. On convalescent and minimal care wards, most patients can put on their masks. For those who cannot, other patients can assist them after putting on their own masks. On the intermediate care wards, some patients will be able to put on their masks, but many will require assistance. Patients should assist each other put on their mask; especially on the minimal care wards. Intensive care and emergency room staff will have to assist their patients in masking.

• Many patients with head and neck wounds, or who are on life-support devices will be unable to wear their individual protective masks; these patients must be placed in PPW. While the PPWS have two ports for intravenous or blood infusion lines, the staff may have to adapt for other devices (Foley catheters, traction, and cardiac monitor) by using tape and other means to seal the gaps created in the seal around the edge of the PPW. Patients requiring assisted ventilation are at extreme risk, unless their air supply is protected. The sequence of protecting everyone is mask yourself first; assist those patients who can wear their protective masks; and then place patients in the PPW.

(d) Materiel protection. Protection of materiel, especially expendable supplies, requires covers and barriers. All materiel not required for immediate use is kept in shipping containers, medical chests, or under cover (tentage, plastic sheeting, and tarpaulin) for protection against particulate or liquid hazard. Protection against vapor hazard may require multiple barriers through which the vapor must penetrate. For example, intravenous solutions are in their individual plastic bags, in the cardboard shipping box, on a covered pallet, in a MILVAN. This presents four barriers against the vapor hazard. These principles should be used to the maximum extent practical.

6-3. Decontamination

a. Decontamination of nuclear-contaminated personnel, equipment, and the operational site is as follows:

(1) Monitoring equipment is used to detect contamination; the contamination is then removed by brushing or scraping with brooms, brushes, branches, and so forth. Flushing contaminated areas with water is also effective in removing nuclear contamination. However, there remains

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problems of containing and removing the contaminated water. The best method of containment is to trench the area into a sump for collection of the contamination. This will reduce the area of contamination; however, the level of concentrated nuclear agent may be such that there is an increased hazard to personnel. The collection area must be clearly marked using the standard nuclear hazard signs.

(2) Nuclear contamination of the site normally requires relocation of the hospital. Scraping the top 1 or 2 inches of soil from the area, or covering it with 1 or 2 inches of uncontaminated dirt will not be practical. The commander will determine the need to relocate after considering the contamination level, estimated radiation dose, and the mission.

b. Suspect biological agents should be removed from equipment as quickly as possible. In the absence of agent-specific guidance, clean exposed surfaces using a 5 percent chlorine solution, or copious quantities of soap and water (preferably hot). Liberally apply the hot, soapy water and scrub all surfaces with a brush. Then rinse the surfaces with hot water. As previously discussed, the water used is contaminated and must be controlled and removed to a safe area. Supertropical bleach (STB) and decontaminating solution number 2 (DS2) are effective against most known biological agents because of their caustic nature. If anthrax (or other spore formers) is suspected, repeat the entire decontamination process again to mechanically remove the spores. Other standard biological decontamination agents are described in FM 3-5.

c. Decontamination of chemical contamination is as follows:

(1) *Equipment.*

(a) Personnel use their soldier skills and their personal M258A1 kits to decontaminate their personal equipment. The M13, decontamination apparatus, portable, is used to decontaminate vehicles, trailers, and International Organization for Standardization (IS0) shelters. This apparatus uses DS2 (a highly caustic, flammable solution that cannot be used to decontaminate tentage). The DS2 must be washed off after sufficient time for decontamination has passed (see FM 3-5 for details). Water used for NBC decontamination purposes becomes contaminated; it must be drained off and contained in sumps. This will be difficult in hospital areas because relatively flat sites are needed for hospital complexing.

(b) When hospital tentage becomes contaminated, decontamination operations must be considered immediately. Spot decontamination may be effective for small areas; however, gross contamination of TEMPER and GP tentage is best decontaminated by aging. Without CPS and with persistent agent contamination that absorbs into the tentage and presents a continuing vapor hazard, the hospital stops receiving patients and evacuates all patients as quickly as possible. When large portions of the hospital are contaminated, personnel decontaminate all equipment possible and relocate to a new site, leaving the contaminated equipment to age or be decontaminated by a specialized unit. When small portions of the hospital are contaminated, the contaminated portions are removed to another location for decontamination; hospital operations are continued, but at a lower operational level. For detailed equipment decontamination procedures, see FM 3-5.

(2) Each hospital is issued MES, Chemical Agents Patient Decontamination, for use in decontaminating patients. These sets are accompanied by MES, Chemical Agents Patient Treatment, for treatment of chemical casualties. Each hospital must decontaminate and treat its personnel who become casualties; chemical casualties from units in its general area; or contaminated patients received from lower echelon MTFs. See Appendix C for patient decontamination procedures. See Appendix D for establishment of a patient decontamination and treatment station.

6-4. Emergency Services

a. Providing emergency services will be complicated by several factors:

- Varying levels of treatment received prior to arrival at the hospital.
- Combined conventional wounds and NBC agent effects.
- Heat-related complications associated with MOPP use.
- Psychological effects due to chemical agents, the impact of NBC weapons, or the isolation of MOPP gear.
- The need to have EMT personnel at the arrival point, decontamination site, and in the EMT area itself.
- The potential of having to triage and provide patient care while in MOPP gear.
- The need to provide supervision/guidance to the decontamination augmentation personnel from the supported units. These personnel may be of any military occupational specialty (MOS), except medical. They will use hospital equipment and supplies to decontaminate patients.

b. Contaminated patients must be triaged in the decontamination area that is established at the hospital. Contaminated patients **will not** be brought into the clean EMT area until decontaminated. All patients are screened for contamination. Based on the findings, the patient is routed to the contaminated triage station, or to the clean triage station. Contaminated patients are triaged, then routed to the decontamination area, or to the contaminated treatment area. Patient admission to the clean treatment area may be delayed; however, life- or limb-saving care is provided in the contaminated treatment area before decontamination.

6-5. General Medical Services

a. The provision of general medical services in the hospital will be continued with minimal interruptions in the NBC environment. The noninvasive nature of these services allow their continuation at most MOPP levels.

b. General medical services will be constrained by MOPP Levels 3 and 4 and the mask-only posture. Most of these constraints will be—

- Communication limitations,
- Loss of the oral route for administering medications to patients.
- Limited ability to accurately evaluate the eyes, nose, and mouth of patients wearing a protective mask.
- Reduced ability to perform examination/assessment of patients in PPW or MOPP Levels 3 and 4.
- Inability to provide oxygen therapy or ventilator support to a patient in a vapor hazard environment, unless a CB filter mask is available.

- Logistical constraints based upon the fact that key areas such as dietetics, supply, and laundry are not in CPS. These three services may be reduced or delayed in the NBC environment.

6-6. Surgical Services

a. Surgical services will be severely limited in the NBC environment. At any level above MOPPO, surgical services are halted except for life-or limb-saving expedient procedures. Surgery cannot be safely performed outside a CPS due to a variety of factors including—

- Lack of protected ventilation for patients during and after surgery.
- Inability to maintain a sterile field while using MOPP gear.
- Direct access for agent through open wounds to the circulatory and respiratory systems.
- Decreased dexterity and vision resulting from MOPP gear use.
- Inability to quickly place the patient in a PPW should the need arise.

b. Due to the relatively high number of trauma cases, hospital services may be severely constrained by NBC contamination. The hospital location and the possible need for hasty relocation are two major planning considerations for the command staff.

c. Patient accounting and medical regulating are critical factors in the transfer of patients from a hospital without CPS that must move out of an NBC environment. Hospitals without CPS stop receiving patients when a persistent hazard is identified; patients on hand are transferred to a clean hospital.

6-7. Nursing Services

Providing nursing care is influenced by the amount of protective gear worn by the nursing staff and the patients. The patients may be in their MOPP gear, in a PPW, or wearing only their protective mask; any of which will interfere with care. Nursing personnel may be at any MOPP level, or in protective mask only.

a. Direct assessment of a patient's vital signs is extremely limited at MOPP Level 3 or 4; however, a carotid artery pulse can be taken by palpating the neck area. The patient's respiratory rate and level of consciousness may be assessed visually. Palpitation of the blood pressure through a PPW may be possible if it is relatively strong, or at least in the normal range. The patient's temperature cannot be monitored; this is an area of concern due to the possibility of heat stress.

b. Only gross neurological signs can be assessed through the PPW. However, even this assessment is complicated by the presence of miosis and by the health care providers mask. Cardiac and urinary output monitoring is continued uninterrupted for patients wearing a mask only, and for patients in the PPW.

c. Oral hygiene and bathing are postponed until a safe environment is available (MOPP Level 2 or less). All toileting will occur within the hospital complex using bedpans, urinals, a bucket, a container with a plastic liner, or a chemical toilet.

d. At MOPP Level 3 or 4, feeding must be postponed. A nutritional assessment is needed to determine how long each patient can tolerate a fasting state when the MOPP Level 3 or 4 remains for over 24 hours.

e. Intravenous (IV) medications are mixed in a CPS area, or in a clean area and then transported in a protective wrap (multilayers of plastic, medical chest, or layered cardboard) to the user. However, IV solutions, blood, and injections can be given to patients on an unprotected ward. Normally, oral medications are only given at MOPP Level 2 or lower.

f. Treatment procedures that have the potential of contaminating the patient's pulmonary or circulatory systems are conducted only at MOPP Level 2 or below. However, EMT procedures may have to be performed in the contaminated treatment area, or the patient decontamination area.

g. Continuous oxygen therapy requires a collective protection environment or a CB filter supported respirator.

h. Delivery of nursing care at MOPP Level 3 or 4 is limited due to the sensory restrictions of MOPP gear. Time is taken to reassure the patients on a personal basis, as much as possible, and by routinely monitoring the ward environment. Communications are difficult and identities are masked. Use of handwritten name tags for staff and patients (including patients in PPW) to ensure that the identity of all personnel is maintained.

i. As with all procedures, the time required for record keeping rises markedly at MOPP Level 3 or 4. Contaminated paperwork cannot be evacuated with the patient. Transcribe essential information onto uncontaminated documents for evacuation with the patient. A record of patient exposure time to a contaminated area is prepared to assess the cumulative risk to the patient.

CHAPTER 7

OTHER HEALTH SERVICE SUPPORT

Section I. PREVENTIVE MEDICINE SERVICES

7-1. General

On the integrated battlefield, PVNTMED services will be in greater demand than at any other time, especially under biological warfare conditions. Preventive medicine personnel will be called upon to assist the commander in determining the health hazards associated with nuclear fallout; the safety of drinking water in an NBC environment; as well as determining when to use prophylaxis, immunizations, and other PVNTMED measures (PMM) associated with NBC warfare. Preventive medicine personnel must be aware of the medical threat in the AO. They must continually update their data base on diseases, potential disease vectors, and the susceptibility of troops to these diseases. Under NBC conditions, diseases may be manifested that are known to exist in the area, but were not being transmitted to our forces. The appearance of diseases, or arthropods not known to exist in the AO are indicators that biological warfare agents have been used.

7-2. Disease Incidence Following the Use of Nuclear Weapons

a. Determining Factors. Factors of prime importance in determining the nature and severity of the effects are—

- Population density.
- Degree of industrialization.
- Availability of food supplies.
- Availability of water.
- Climate.

Other considerations such as the moral and legal requirements to defend and assist allies, including civilians, will also affect HSS planning and operations. Finally, the manner and situation in which nuclear weapons are used are of importance. A single weapon detonated in a socially stable area will have far less serious effects than a detonation in an area where combat has already disrupted the social stability. At Hiroshima and Nagasaki (excellent examples of the first type of situation), the survivors who could get away were able to obtain food, shelter, and care from surrounding intact areas. With prolonged combat operations, such intact areas would not be available, resulting in no food, shelter, or care for any survivors. Social order will breakdown and there will be slack of effective medical care; including PVNTMED functions and facilities.

b. Disease Incidence. Without PVNTMED capabilities, increased incidence and morbidity from diseases will follow. Some diseases will predominate in incidence, depending upon the geographical areas involved and the endemic diseases present.

(1) In urban areas in temperate climates, several diseases are epidemic threats. These epidemic threats may include—

- Dysenteries due to a variety of pathogens.
- Rickettsial diseases, particularly typhus and scrub typhus.
- Hepatitis.
- Plague.
- Tuberculosis.
- Sexually transmitted diseases.
- Malaria and cholera in many parts of the world.

(2) There are several reasons for the increased risk of disease, including—

- Crowding of surviving populations with limited sanitary facilities, such as was seen in Europe at the end of World War II.
- Lack of immunization facilities with resultant increases in the susceptible fraction of a given population.
- Lack of pest management.
- The effect of irradiation on susceptibility to infection. With the high levels of fallout covering wide areas, a large number of people would sustain sublethal whole-body doses of irradiation. The interaction of irradiation with infections is not clear; it is possible that the result is uncovering latent infections and decreased resistance to infection. This may result in an increased incidence of disease.
- Upsets in ecological balance and host-parasite relationship following the use of nuclear weapons. Different classes and orders of animals have marked differences in sensitivity to irradiation. Arthropods, for example, are much more resistant than are vertebrates. The normal balance between arthropods and birds which prey upon them in a given area may be severely upset, resulting in a marked overgrowth of the arthropods. If these included vectors of disease or arthropods which destroy vegetation, there would be a serious increase in disease hazards, or serious destruction of food crops.

7-3. Preventive Medicine Section

The PVNTMED section of the divisional and nondivisional medical companies perform analysis on water sources and supplies to determine the presence or absence of NBC agents; see Appendix E for additional information. Based upon their findings, the water is released for consumption, or is restricted from use until it is treated (usually by quartermaster personnel using the reverse osmosis water purification unit). This section conducts limited entomological surveys to determine the existence of disease-vectoring arthropods in the AO. They inspect food service facilities to determine the extent, if any, of NBC contamination. They evaluate the unit's immunization status; the unit's

use of prophylactic drugs for specific diseases (such as antimalarial tablets); unit personnel's use of nerve agent pyridostigmine pretreatment tablets, if warranted; and the unit's application of personal hygiene and field sanitation procedures. Based upon their findings, they provide recommendations for corrective actions to the commanders. They assist in training unit field sanitation teams (FM 21-10- 1). They are not members of the unit field sanitation team.

7-4. Environmental Sanitation Detachment

The PVNTMED Detachment (Sanitation) provides PVNTMED services on an area basis to units within their assigned AO. These services include, but are not limited to—

- Conducting water surveillance, including NBC contamination.
- Performing food service sanitary inspections.
- Conducting arthropod surveillance and limited pest management.
- Providing epidemiological consultation.
- Advising commanders on the employment of PMM.
- Training the supported units' field sanitation teams.

7-5. Entomology Detachment

The PVNTMED Detachment (Entomology) provides PVNTMED services on an area basis to units within their assigned AO. These services include, but are not limited to—

- Conducting pest (arthropod and rodent) surveys and surveillance.
- Conducting arthropod control (ground and air) operations. The aerial spraying missions are dependent upon availability of helicopter support.

Conducting limited water surveillance, including NBC contamination.

- Providing limited epidemiological consultation.
- Advising commanders on the employment of PMM.
- Training the supported units' field sanitation teams.

Section II. VETERINARY SERVICES

7-6. General

The US Army Veterinary Service is the Executive Agent for veterinary services to all services within the Department of Defense (DOD). They ensure that food supplies are safe and provide veterinary

medical and surgical care for government-owned animals throughout the TO. On the integrated battlefield, their role is particularly important; the potential for food supplies becoming contaminated with NBC agents is high.

7-7. Food Protection

The potential for terroristic contamination of food procurement facilities and food supplies is real. The NBC agents may be introduce during production, or in the storage area of the procurement facility; while the product is in transit; at the military storage facility; or the unit food service facility. Regardless of where the agent is used, the effect is the same; personnel will become ill or die if they consume the contaminated food. For this reason, veterinary personnel inspect and monitor food from its procurement until it is issued to the consumer to ensure its safety. Throughout the TO, all services (Army, Navy, Marine, and Air Force) logistics personnel must take precautions to protect subsistence from contamination.

7-8. Animal Care

Veterinary personnel are concerned with the protection of government-owned animals and animals being procured for consumption by our forces. Protection and veterinary care of government-owned animals can be a challenge to veterinary personnel. Animals must be protected from NBC contamination whenever possible. Animals should be moved into enclosures to protect them as much as possible from contamination. Protective equipment is not available for military working dogs. However, protection of the animal's feet and body must be considered. Butylrubber boots can be used as foot covers when dogs must cross a contaminated area. Since CPS systems are not available, animal treatment facilities must be established in contamination free areas. Veterinary treatment personnel must remain in MOPP 4 when caring for NBC animal casualties until the animals have been decontaminated. The treatment of military working dog chemical agent casualties is outlined in Chapter 7, FM 8-285. Animals suffering from the effects of biological or nuclear weapons must be treated symptomatically.

7-9. Food Decontamination

All food suspected of being contaminated with NBC agents must be inspected for wholesomeness by veterinary personnel before used. Appendix F provides guidance on the decontamination of subsistence. Veterinary personnel are involved in the detection and monitoring of NBC contaminated rations. Veterinary personnel provide advice on the decontamination of rations to unit personnel owning the rations, or chemical personnel performing the actual decontamination. Depending on the type of contamination and packaging, the food may be—

- Consumed without being decontaminated;
- Decontaminated and consumed; or
- Destroyed.

Some items may be held to allow time for natural decay of nuclear or chemical contamination before consumption. The decision on disposition of the food is made by veterinary personnel and the commander. However, the final determination of food safety is made by veterinary personnel.

Section III. LABORATORY SERVICES

7-10. General

Laboratory services must continue their support role even under NBC conditions. For the provision of clinical and diagnostic support, the facility must be located in a contamination free area or be inside collective protection. Designated laboratories within the theater will analyze biological specimens (including initial presumptive identification of biological agents by evaluating specimens from symptomatic patients) and selected environmental samples collected from the AO. See Appendix G for procedures in collecting biological specimens.

7-11. Echelon II

Laboratory support at this echelon is extremely limited; it consists mainly of laboratory procedures in direct support of ATM activities. Collection of biological specimens for laboratory investigation of biologic or chemical agents use is required. Biological specimens are forwarded to supporting laboratories.

7-12. Echelon III

In the rapidly developing theater, laboratory support in MASH and CSH units is limited to acute surgical cases, blood services, and statim (STAT) services required for intensive care operations. Only extremely limited microbiology services (parasitological exams and gram stains) are provided. In a mature theater, the microbiology services may be augmented to include limited cultures and sensitivity testing. Patients with documented or suspected exposure to biological or chemical agents will be medically evaluated and specimens will be forwarded through technical channels to supporting laboratories as established within the theater TSOP.

7-13. Echelon IV

a. Clinical Laboratories. The clinical laboratories in the field and general hospitals will have microbiological capabilities to provide presumptive identification of a limited number of biological agents in a variety of tissue and fluid samples. Ability to detect chemical agents in biological samples will require forwarding specimens to a more sophisticated supporting laboratory in the theater.

b. Area Medical Laboratory. The area medical laboratory (AML) is the specialized laboratory within the theater that provides laboratory procedures with a focus on the command total health environment. A major laboratory focus is the evaluation of suspected NBC and directed energy health hazards. Using extremely sophisticated equipment and methods, the AML has the capability to detect and identify biological and chemical agents in a variety of biological, environmental, and animal specimens. Direct support from CONUS-based laboratories will aid the AML with positive confirmatory identification of biological agents. Definitive patient treatment may be based on the analytical and consultative support provided by the AML. Proper collection and rapid shipment of specimens by supported MTFs will ensure effectiveness, timely, and accurate laboratory analyses.

7-14. Zone of Interior

Designated zone of interior laboratories perform definitive analyses to provide positive confirmatory identification of suspect biological agents.

7-15. Field Samples

Chemical corps personnel collect environmental, air, soil, and vegetation samples. Preventive medicine personnel collect samples from drinking water sources and supplies. Veterinary personnel collect samples from food supplies. Samples will be subjected to initial screening with rapid test kits and further analysis in a definitive testing laboratory. Assets, both within the theater as well as in the CONUS base, will test environmental samples for possible contamination with biological and chemical agents. Comprehensive data bases will be maintained to provide historical testing results and will aid in the field commander's decisions to conduct operations in an NBC environment.

7-16. Biological Specimens

Specimens are collected from patients at MTFs throughout the TO. These specimens may include vomitus, urine, blood, tissue, sputum, bone marrow, and spinal fluid. Specimens may be collected during special operations by medical personnel that are attached to lead elements of special operations forces conducting NBC reconnaissance. Specimen collecting techniques and handling are critical to accurate analysis. Routine and specialized collection techniques will be employed to obtain specimens for laboratory evaluation. Equally sophisticated methods of processing and shipping will ensure that referral laboratories receive viable specimens to analyze.

Section IV. DENTAL SERVICES

7-17. General

Dental service support is provided at Echelons II, III, and IV on the integrated battlefield. Because of their location close to main supply routes, CS, and CSS assets, dental units are vulnerable to an NBC strike. Nuclear, biological, and chemical operations have an impact at all echelons. Dental personnel may be directly affected by NBC agents in their AO, or indirectly when treating contaminated patients. Dental units must be prepared to survive and provide HSS on the integrated battlefield. Defense against NBC weapons must be included in the dental unit's TSOP. Individual and collective tasks must be intensely trained on a regular basis; survival depends on the ability to use basic survival skills in the event of an NBC attack.

7-18. Mission in a Nuclear, Biological, or Chemical Environment

The overall mission of dental units to provide dental services is greatly affected in the aftermath of an NBC attack. First, the unit must survive the attack and rapidly recover from its effects. Secondly, in the event of mass casualties, the patient care effort must be redirected from dental treatment to the alternate wartime role of augmenting adjacent MTFs. Providing dental services in an NBC environment will generally be limited to the treatment of maxillofacial emergencies requiring immediate attention.

7-19. Dental Treatment Operations

As a general rule, in the aftermath of an NBC attack, dental treatment operations cease until deliberate decontamination of the unit and its equipment has been accomplished. Only maxillofacial injuries of an immediate life-threatening nature should be considered for treatment. After an attack, the resources of the dental treatment facility (DTF) are redirected toward support of any mass casualty situation which may have been generated at an adjacent MTF, or toward decontamination and relocation to a noncontaminated area.

7-20. Patient Treatment Considerations

The only category of dental treatment appropriate in an NBC environment is emergency; and then, only those emergencies of an extreme nature which demand immediate attention. The most likely condition requiring such attention would result from maxillofacial trauma and would be most likely to present at an MTF rather than a DTF. Although the likelihood of a requirement to treat dental patients in an NBC environment is extremely low, DTFs must have a plan in the event that such patients do present.

a. Patient Decontamination. Decontamination of patients, dental patients included, is an absolute requirement before treatment can be rendered. Contaminated patients are triaged and decontaminated before treatment (except for life- or limb-care). Both triage and decontamination should be accomplished as far forward as possible. Specific details on patient decontamination are in Appendix C. It is important to note that normally patient decontamination is not performed by medical or dental personnel. Initial decontamination at the basic skill level is accomplished at the casualty's unit. Detailed patient decontamination is accomplished by the patient decontamination teams (made up of nonmedical personnel from the supported units) that are supervised by medical personnel at the MTF.

b. Patient Decontamination at Dental Treatment Facilities. Neither dental units nor their subordinate DTFs are equipped to support detailed patient decontamination. Any contaminated patients arriving at a DTF requiring urgent attention must be directed or evacuated to the nearest MTF with a patient decontamination capability prior to treatment.

7-21. Patient Protection

Dental treatment facilities must also consider the need to protect patients in their care in the event of an NBC attack, or when the threat of an attack is high. Special consideration must be made for maxillofacial patients whose condition prevents them from wearing their protective mask.

a. Immediate Response. In the event of an attack or when the alarm sounds, dental treatment providers immediately cease work and mask. The patients should do likewise. Only after putting on their own masks, do the dental treatment providers assist the patient, if necessary, by removing materials which impede the patient's masking. Only those materials which impede masking or may compromise the airway (such as rubber dam frames or impressions) are removed, the rest are left in place until the all clear is sounded. Special attention must be given to patients who may have been medicated into a less than fully conscious state, or are otherwise incapacitated.

b. Mission-Oriented Protective Posture Considerations. The MOPP level should be taken into account when determining the category and extent of dental treatment to be provided. Patients,

including those seated in the dental chair, should be at the MOPP level prescribed for the DTF by its parent headquarters. Dental treatment at MOPP Levels 3 and 4 is, of course, rendered impossible by the requirement to wear the protective mask; however, treatment is still possible at Levels O, 1, and 2. Treatment at MOPP Level 2 should be limited only to emergency care requiring urgent attention. At MOPP Level 1, most types of dental emergencies can be accommodated; however, only minimal essential treatment should be undertaken in order to reduce risk of the patient being caught in a compromised state. At MOPP Level O, the provision of dental treatment generally is not limited. However, the degree of the NBC threat forecast for the area should be considered before undertaking extensive treatment.

c. Maxillofacial Injuries. Patients with maxillofacial injuries which prevent proper fit and seal of the individual protective mask must be placed in a PPW. Though patients with these types of injuries are most likely to be found only in MTF channels, DTFs should nevertheless be prepared. The DTFs should maintain one or two PPWS on hand for this purpose. Currently, the PPWS are available only in the chemical agent patient treatment set that is organic to MTFs. Thus, special arrangements for their procurement for dental use must be made with either adjacent MTFs, or the servicing medical logistics battalion.

Section V. COMBAT STRESS CONTROL

7-22. General

When operating under the threat of or under actual NBC conditions, soldiers will be at a higher risk of suffering combat stress-related conditions. The invisible, pervasive nature of many of these weapons creates a high degree of uncertainty and ambiguity; presenting fertile opportunities for false alarms, mass panic, and other maladaptive stress reactions. The persistent or delayed effects of some NBC weapons will create fear for the future, the homeland, and perhaps even for the survival of civilization. Therefore, commanders and leaders must take actions to prevent and reduce the numbers of combat stress cases in this environment. The symptoms and physical signs caused by excessive stress are similar to some signs of true NBC agent injury. In World War I, inexperienced units initially evacuated two pure stress cases for every one true chemical casualty. Some minor chemical casualties, also had major stress symptoms. Therefore, far forward triage is essential to prevent over evacuation and loss of the individual to the unit.

7-23. Leadership Actions

a. Keep Personnel Informed of the Situation. Keep information flowing, dispel myths, and control rumors by—

- Discussing the situation and its possible long-term implications honestly.
- Maintaining the perspective that the best chance for mission accomplishment is assured when the unit and the Army stays effective, practices AirLand Operations doctrine, and defends the democratic system of the United States.

b. Train Soldiers to Survive. Emphasizing the intention of the United States Army is deterrence. Use training procedures that—

- Tell the lessons of history on NBC weapons employment. Show that the enemies' use of NBC weapons will not give him enough advantage to justify the risk to his forces.

- Training increases the chance of surviving and winning should the enemy use NBC weapons.

c. Put NBC Defense in Realistic Perspective. Continuously strive to maintain a realistic perspective in the unit by—

- Comparing the risks of the threat with the increased risk of facing the conventional threat in varying levels of MOPP. The decision to initiate a MOPP level should be like deciding how much cover is needed to protect a unit from conventional weapons.

- Choosing the lowest MOPP level that protects the unit, yet permits accomplishment of the mission. That's what the "MO" in MOPP stands for! Do not try to be 100 percent safe from chemical attack if it means that there is—

    - Only a small chance of mission accomplishment.

    - A high probability of being killed by the enemy.

    - A high personnel loss due to heatstroke.

- Emphasizing buddy aid as a means of keeping watch for each other. Personnel should always seek buddy aid before taking additional antidotes. This will reduce the numbers of individuals using their antidotes when not needed; and prevents the increased heat stress caused by the effects of atropine on the body's cooling capabilities.

d. Reduce Ambiguities. Have unit and scenario-specific SOPS with clear, objective criteria on when MOPP is to be assumed or increased.

e. Train in the Protective Mask. Train in the protective mask often. It takes repeated wear and time to acclimate and get over the claustrophobic feeling of wearing the mask. The training can be conducted during a variety of activities.

- Have personnel wear the mask often in garrison or lulls, even at desk jobs. If on average, one person in five wears the mask at any given time, everyone will quickly become familiar with it.

- Periodic prolonged wear (8 hours or more) helps soldiers get over the hump and realize that they can tolerate the discomfort.

- Have personnel wear the mask while performing combat related (mission essential) tasks.

f. Train in Mission-Oriented Protective Posture Level 4. Training in MOPP Level 4 (or simulated MOPP 4, which is to overdress while wearing the protective mask, overboots, and gloves) will increase personnel confidence in their abilities to wear the ensemble.

g. Issue Each Soldier a Protective Mask. Issuing each soldier a mask ensures that the mask is the correct size. This places the responsibility of maintaining the mask on the individual. It gives the individual a feeling of trust, confidence, and even grudging "cohesion" for the mask.

h. Assure that Sleep Plans are Safely Practiced. Have everyone practice sleeping with their mask on. Buddies observe each other to assure the mask is not obstructing or stopping breathing. Assure that sleep is done only in safe places. Require ground guides for all vehicles in the unit bivouac area. Plan should provide at least 4 hours of uninterrupted sleep during every 24 hour period.

i. Drill to Prevent Accidental Fratricide. Being in MOPP with restricted hearing and vision makes people jumpy. They are more likely to shoot without clearly identifying or challenging the target. The rate of accidentally killing one's own side can rise alarmingly. Leaders are at special risk, they must move around more to maintain unit cohesion and control; they tend to get tired and careless. Drill relentlessly at target coordination and sign/countersign procedures.

7-24. Individual Responsibilities

a. Follow Orders. By following orders, individuals can increase their ability to cope with and prevent combat stress-related conditions. Survival on the battlefield depends on each individual's ability to cope with stressful situations. Coping with the stresses of an NBC environment requires extra individual action. Concentrate on the positive aspects of survival, not the negatives of illness or death. Leaders cannot perform this role for soldiers.

b. Train. Use every opportunity to train while wearing the protective mask and the entire MOPP ensemble, when permitted. You build self-confidence and endurance by frequent training with your protective mask, or at MOPP Level 4.

c. Use Buddy System. Using the buddy system increases each soldier's ability to survive. Soldiers looking out for each other give a sense of security that relieves stress. Looking out for each other improves every individuals' ability to perform his duties.

7-25. Mental Health Personnel/Combat Stress Control Responsibilities

a. Staffing for Combat Stress Control. Combat stress control is provided by the following activities or units:

- Division Mental Health Section.
- Area Support Medical Battalion Mental Health Section.
- The Neuropsychiatric Ward and Consultation Service of each CSH, Field Hospital, and General Hospital.
- Medical Detachment, CSC.
- Medical Company, CSC.

b. Conduct Preventive Activities.

(1) Prevention is the most economical means of controlling combat stress reactions; not only for the line Army's mission, but also for the HSS mission. In an NBC environment, this is even more critical. Personnel must begin consultation services before NBC weapons/agents have been employed. Contact and rapport with the consultees before action begins increases the

probability of preventing numerous stress reaction cases. The best method of conducting consultation is one-on-one in the individual's duty area. Each session should be brief, but thorough; the individual should leave the session feeling that he has been helped. In some instances group sessions will be adequate to prepare personnel for expected times of stress. Successful consultation depends upon trust and familiarity between the consultant and consultee.

(2) For a successful preventive program, unit leaders must be included in the program. Leaders require as much assistance as do individual soldiers.

(3) When the mission permits, attend social functions of the supported units. Go running with them periodically.

(4) Conduct briefings, classes, and (best of all) practical exercises in topics such as—

- Combat stress/battle fatigue recognition and management (adjusted to the branch, rank, and duties of the audience).
- Stress management and relaxation techniques.
- Sustaining performance in continuous and sustained operations.
- Psychological aspects of NBC defense.
- Building unit cohesion.

(5) Deploy with the unit on field training exercises and training center rotations. Actively participate in all unit NBC or MOPP training.

(6) Use scheduled gas chamber exercises and predeployment protective mask tests as an opportunity to introduce yourself to all unit members; also to reinforce stress control training, Assist any soldier that is having mask claustrophobia to master it. Ensure that unit leaders use the chamber to build confidence in the training and protective equipment.

(7) Monitor indicators of excessive stress in units. Actions and activities that indicate stress problems in a units include—

- Increased disciplinary actions.
- Suicide gestures/attempts/completions.
- Threat and fratricide actions against leaders, or unit members.
- Homicides.
- Alcohol and drug abuse.
- Sources of information include, but are not limited to, the supporting MTF, PVNTMED section/teams, chaplain, and military police.

c. Control Stress Reactions. Combat stress requires proper management. The evaluation of overstressed soldiers is difficult but not impossible when both the soldier and the evaluator are in

MOPP. The primary method of mental health evaluation is the interview and mental status examination. Problems associated with monitoring vital signs and doing a physical assessment to determine organic injuries or illnesses in MOPP are discussed elsewhere in this manual. Distinguishing between organic and functional conditions is especially critical and problematic in NBC situations. Table 7-1 provides signs and symptoms of combat stress. One early sign of stress is a notable reluctance of a soldier to leave a secure setting. Example: The last soldier in a column continually looking over his shoulder toward the safe area; he constantly checks and rechecks his equipment and has difficulty understanding instructions. Over time, affected soldiers may become incapable of action even during danger; they may exhibit tics, trembling, shaking, and even unresponsiveness which may be mistaken for true epileptic or nerve agent poisoning seizures. These reactions can also resolve rapidly. If rapid recovery does not occur following treatment in the field, the presence of a more severe psychiatric condition should be suspected.

Table 7-1. Acute Combat Reactions

SIGNS AND SYMPTOMS
RELUCTANCE TO LEAVE A SECURE SETTING
UNCONTROLLED BODY MOVEMENTS
DIFFICULTY COMPREHENDING AND FOLLOWING INSTRUCTIONS
SYMPATHETIC NERVOUS SYSTEM AGITATED
LIFE-THREATENING BEHAVIORS
POSSIBLE OVERFLOW OF MOTOR ACTIVITY
POSSIBLE PARALYSIS
OVERWHELMING FEAR
ENVIRONMENTAL
FATIGUE, HUNGER, COLD, HEAT, AND SLEEP DEPRIVATION
INTENSITY OF THE BATTLE
DISORIENTATION
SURPRISE
INTERPERSONAL
LACK OF UNIT COHESION AND ESPRIT
LACK OF LEADERSHIP
CONFUSION
SUPPORT ASSIGNMENT VERSUS FRONT LINE
PERSONAL
AGE
INEXPERIENCE
LACK OF COMMITMENT TO BATTLE
WITNESSING DEATH FOR FIRST TIME

Section VI. HEALTH SERVICE LOGISTICS

7-26. General

The protection of medical supplies and equipment on the integrated battlefield is a must. The HSS system will grind to a halt without these supplies. The flow of supplies must continue to forward units as they are requested, including during NBC operations.

7-27. Protection of Supplies in Storage

The protection of supplies can be accomplished by placing them under tents, using plastic wraps or providing storage warehouses with CB filtered-conditioned (heated or coo,led) air systems, Wrapping supplies in two layers of plastic material provides protection from most agents for a short period of time; the thicker the plastic material the longer the protection. Protection from the thermal and blast effects of nuclear detonations requires much more elaborate measures. Placing the supplies in trenches, inside earthen berms, behind stone walls, or in other field expedient facilities will enhance the protective posture of supplies from the nuclear effects.

7-28. Protection of Supplies During Shipment

During shipment, supplies are protected by placement inside MILVANS or container express (CONEX), in covered enclosed vehicles, wrapping them in several layers of plastic, in tarpaulins, or other protective material. To monitor exposure of supplies to chemical agents during shipment, place M9 detector paper between the wrappings. If exposure is limited to the outer layer, simple removal of this layer may be all that is required to eliminate the contamination.

7-29. Organizational Maintenance

Maintenance on vehicles, equipment, and biomedical equipment will provide a challenge to HSS personnel. Most chemical agents are soluble in organic solvents such as gasoline, motor oils, and lubricants. The agent may be removed from the equipment by these solvents, but exposure to the contaminated solvents will produce the same effects as exposure to the agent on the equipment. The agents may seep down around the threads of bolts, in cracks and crevices of the equipment, and inside the cabinets or enclosures of equipment. These potential contamination sources produce an increased hazard to maintenance personnel. Decontamination of some items, especially biomedical equipment, may be a problem for maintenance personnel. The use of standard decontamination agents will cause damage beyond repair to most biomedical equipment and electronic equipment. In some instances, removal of chemical agents will require aging (off-gassing) of the agent. Turning the equipment on and running it, or just exposing the equipment to warm air will speed the off-gassing process. Maintenance personnel must perform all procedures in MOPP Level 4 until decontamination is completed.

APPENDIX A

GUIDELINES FOR HEALTH SERVICE SUPPORT IN A NUCLEAR, BIOLOGICAL, AND CHEMICAL ENVIRONMENT

A-1. General

As the HSS unit prepares for its support role, NBC considerations must be included. This appendix provides guidelines for HSS planning and operations in an NBC environment.

A-2. Predeployment

When preparing the unit's mobilization plan and TSOP include the supplies and equipment that will be required for the unit to operate in an NBC environment. DO NOT wait until ordered to mobilize to begin preparation for the mission. A well prepared and trained unit stands a much better chance of surviving and accomplishing their assigned mission. At a minimum include the following:

- Nerve agent pretreatment and antidotes (see FM 8-285).
- Blister agent antidote/treatment (see FM 8-285).
- Incapacitating agent treatment (see FM 8-285).
- Lung-damaging agents (choking agents) treatment (see FM 8-285).
- Blood agents (Cyanogens) treatment (see FM 8-285).
- Prophylaxis for suspect biological agents (based on threat in AO).
- Biological agent treatment (based on suspect threat agent in AO).
- Protective mask with hood.
- Replacement filters for protective mask.
- Two sets of MOPP per individual assigned to unit.
- All TOE radiation detection equipment.
- All TOE chemical agent detection equipment.
- All TOE NBC alarm systems.
- Biological agent detection equipment, if available.
- Decontamination equipment and supplies (DS2, STB, pails, sponges, mops, decontaminant application apparatus, individual skin decontamination kits).
- Material for covering supplies and equipment (such as plastic sheeting, tape, tarpaulins).
- Material for preparing improvised protection in shelters (such as plastic sheeting, tarpaulins, tape, sandbags).

- Collective Protection Shelter systems with repair parts (MTFs).
- Chemical warfare agent patient decontamination medical equipment set (MES). The MES can also be used to decontaminate nuclear and biological patients.
- Chemical warfare agent patient treatment MES. Components may also be used to treat nuclear and biological patients.
- Water supply for patient decontamination.
- Shovels.
- Sanators.
- Identification of patient decontamination team members from supported units.
- Applicable references (ARs, FMs, TMs, and SOPs).

A-3. Mobilization

During mobilization the unit must ensure that all supplies and equipment are on hand and are serviceable. Commanders and leaders of MTFs must also ensure that—

- Movement plans are prepared.
- Transportation support requirements are identified and requested.
- Load plans include NBC supplies and equipment.
- Mission-oriented protective posture level has been established for the movement, when applicable.

A-4. Establishing a Medical Treatment Facility

When establishing an MTF, some types of CPS must be set up as the conventional shelters are being set up. Once the conventional shelter has been set up and is operational, CPS cannot be established without first taking down the existing shelter. Follow the technical manual provided with the CPS system issued to your unit. Things to do in preparation for operating in the NBC environment include, but are not limited to—

- Clear the AO. Survey the area to ensure contamination is not present before establishing the MTF.
- Establish detection stations on the units perimeter.
- Determine direction of prevailing wind. All contaminated patients, ambulances, and helicopters must arrive on the downwind side of the MTF; this must be done with or without CPS.

- Set up of the triage, patient decontamination, and contaminated treatment area (including overhead cover).
- Establish the contaminated ambulance point.
- Establish the contaminated helicopter landing area.
- Prepare the contaminated waste dump.
- Establish the clean ambulance point.
- Establish the clean helicopter landing area.
- Mark the hot line and prepare the shuffle pit.
- Employ CPS system (close shelter, CB filters, close air locks, maintain overpressure), if available.
- Establish the clean treatment area 30 to 50 yards (meters) upwind of hot line, when CPS is not available.
- Ensure provisions for overhead cover at the patient decontamination area.
- Request patient decontamination personnel from supported units (BAS and DCS), or units located within the geographic area (hospitals).
- Request issue of chemical patient treatment and decontamination MES, if not on-hand.
- Establish contamination monitoring procedures in CPS.
- Establish control procedures for personnel crossing the hot line (through the shuffle pit).
- Establish CPS entry and exit control procedures (see Appendix D).
- If CPS is not available at hospitals, improvisations must be made (Appendix B).

A-5. Operate a Medical Treatment Facility Receiving Contaminated Patients

An MTF must be prepared to receive contaminated patients. All actions listed in paragraph A-4 above must be taken. During operations actions that must be taken are—

- Establish MOPP level commensurate with operation.
- Require all ambulances and helicopters with contaminated (or suspected) patients to stay downwind of the MTF.
- Conduct initial triage, decontamination, and contaminated treatment downwind of the clean treatment area.
- Ensure all personnel crossing the hot line are decontaminated,

- Monitor personnel entering clean area.
- Monitor for contamination in the clean treatment area (with or without CPS).
- Monitor CPS for entry of contamination.
- Provide protection for patients if contamination enters MTF.
- Ensure personnel drink sufficient quantities of water to prevent heat injury.
- Provide protection for personnel and patient in cold environment. Use sheltered/heated area for patient decontamination.
- Provide protection of personnel and patient in hot environment.
- Control contaminated waste.
- Isolate biological agent patients, if necessary to control spread of agent/disease.
- Protect supplies and equipment from contamination.
- Provide medical resupply to clean areas.
- Provide food to personnel and patients in CPS.
- Provide latrine facilities in CPS.
- Provide drinking water in CPS.

A-6. Preventive Medicine Services

Preventive medicine personnel must monitor water supplies for contamination. To perform this mission, equipment and supplies must be available and operational. Essential equipment and supplies include—

- Radiation detection (AN/PDR27, AN/VDR2).
- Preventive Medicine Water Quality Control Set.
- M272 Chemical Agent Detection Set.
- Biological sample collection kit/supplies.

A-7. Veterinary Services

Veterinary personnel must provide treatment to government-owned animals and quality control of food supplies. To perform their mission, essential supplies and equipment include—

- Antidotes/treatment for chemical agent poisoning.
- Radiation detection equipment.

- M272 Chemical Agent Detection Set.
- Biological sample collection kit/supplies.

A-8. Dental Services

Most dental services will have to be suspended in NBC contaminated areas. Emergency services will have to be provided in a clean area or in an MTF with CPS. Essential supplies and equipment include—

- Dental treatment set for maxillofacial injuries.
- Material for covering and protecting supplies and equipment.

A-9. Combat Stress Control

Although specific supplies and equipment are not required for CSC, personnel must be prepared to provide their services under NBC conditions.

A-10. Medical Laboratory Services

Designated supporting laboratories must be prepared to collect specimens of suspect biological agents from humans, water sources, and food supplies. They must also be prepared to perform initial identification of biological agents in specimens collected from humans. They must also be prepared to process samples collected by preventive medicine and veterinary personnel. To perform this mission, supplies and equipment should include—

- General supplies and equipment.
    - Biological specimen collection kits and supplies.
    - Biological test kits or apparatus.
- Microbiology services.
    - Immunology/Serology MES.
    - Microbiology MES.
    - Laboratory, General MES.
- Veterinary services.
    - Laboratory, veterinary MES.
    - Veterinary post-mortem field MES.

- Preventive medicine services.
    - Water, biological sampling supplies and equipment.
    - Radiation protection MES.
    - Entomology MES.
    - Alpha/beta detector.
    - Microscope phase.
    - Ambient air analyzer.
    - Epidemiology MES.

A-11. Health Service Logistics

Health service logistics must continue their support role. To continue this role all supplies must be protected from contamination. Material required includes—

- Detection equipment.
- Plastic sheeting.
- Tape.
- Tarpaulin.

NOTE

These guidelines contain items that are required specifically for HSS operations in an NBC environment. They are in addition to supplies and equipment required for conventional (non-NBC) operations.

APPENDIX B

FIELD EXPEDIENT PROTECTIVE SYSTEMS AGAINST NUCLEAR, BIOLOGICAL, AND CHEMICAL ATTACK

B-1. General

Medical units must have protection from NBC attack and contamination to survive and function effectively. The extent of protection provided is only limited by the resources available and efforts of unit personnel. Protection as simple as an individually dug foxhole, or as elaborate as the subbasement of a concrete building may be used. Expedient protection from the effects of biological and chemical agents are much less labor intensive.

B-2. Protection Against Radiation

The level of protection from radiation is expressed in terms of shielding. Material is available on the battlefield to construct/prepare expedient fallout shelters that offer substantial shielding against gamma radiation (see Table B-l). Generally, the denser or heavier the material, the better shielding it offers. The degree of protection afforded by a fallout shelter is expressed as a "protection factor," or a "transmission factor." The protection factor is simply the fraction of the available radiation dose which penetrates the shelter and reaches those inside compared to the radiation received by an unprotected person. Thus, a protection factor of 2 indicates that an individual in the shelter receives one-half of the radiation dose he would receive if unprotected. A protection factor of 100 (associated with about six half-value thicknesses) indicates that only 1/100 or 1 percent of the radiation dose reaches those inside. Transmission factors are expressed in percentages, or in decimals. Either refers to that fraction of the ambient unshielded dose that is received by personnel within the shelter. Fallout gamma transmission factors for some common shelters are shown in Table B-2.

Table B-1. Shielding Potential of Common Materials Fallout Gamma Protection

MATERIAL	1/2 VALUE LAYER THICKNESS*
STEEL	1.8 cm (.7")
CONCRETE	5.6 cm (2.2")
EARTH	8.4 cm (3.3")
WATER	12.2 cm (4.8")
WOOD	22.4 cm (8.8")

* 1/2 Value Layer Thickness—Thickness of a given material which reduces the dose or dose rate to approximately one-half of that falling upon it.

*Table B-2. Transmission Factors for Nuclear Radiation**

ENVIRONMENTAL SHIELDING	NEUTRONS	INITIAL GAMMA	RESIDUAL
BUILT-UP CITY AREA (IN OPEN)	1.0	0.5	0.7
FOXHOLES	0.3	0.2	0.1
FRAME HOUSE:			
FIRST FLOOR	1.0	0.9	0.5
BASEMENT	0.5	0.3	0.1
MULTISTORY BUILDINGS:			
TOP FLOOR	1.0	0.9	0.1
INTERMEDIATE FLOORS	0.9	0.9	0.02
LOWER FLOOR	0.9	0.5	0.1
BASEMENT	0.5	0.3	0.01
SHELTER, CLOSED 91 CM (3 ft)			
(EARTH COVER)	0.05	0.02	0.005
ARMORED VEHICLES:			
ARMORED PERSONNEL CARRIER	0.3	0.2	0.1
TANKS	0.3	0.2	0.1
WOODED FOREST	1.0	1.0	0.8

*INSIDE DOSE = TRANSMISSION FACTOR TIMES OUTSIDE DOSE.

B-3. Expedient Shelters Against Radiation

a. In many cases it will be unnecessary to construct field expedient or other types of fallout shelters. There are many structures and terrain features available that afford a degree of fallout protection. Tunnels, caves, culverts, overpasses, ditches, ravines, and man-made structures are examples of existing fallout shelters. The best existing shelter is basements. Figure B-1 shows typical shelter protection provided in different buildings. Windows can be sandbagged or covered with dirt from the outside to provide additional protection.

b. Planners should attempt to locate HSS units near existing shelters, whenever possible. However, if an HSS unit is already established, or must be established where fallout shelters are not available, then a shelter must be constructed. Elaborate shelters are not required, since they need be occupied for only a few days. There are a number of field expedients which will serve to save personnel and patients even though they may not be comfortable for those few days.

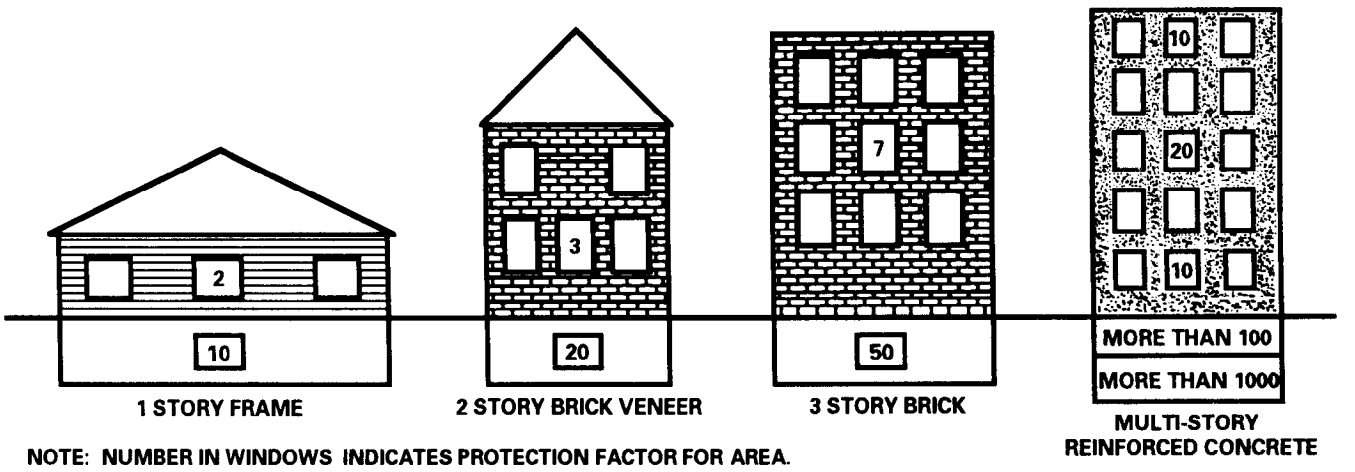

Figure B-1. Typical shelter protection provided in different buildings.

c. When engineer support is available, a dozer trench about 2.7 meters (9 feet) wide and 1.2 meters (4 feet) deep can be dug (Figure B-2). The length of the trench will be determined by the number of patients/personnel to be sheltered. About 0.6 meter (2 feet) length of trench for each person to be sheltered is required. These trenches reduce exposure of personnel lying on the floor to about 20 to 30 percent of the radiation that they would receive in the open. Protection and comfort can be improved, as time permits, by digging the trenches deeper; undercutting the walls (care must be taken in this option; the earth may cave in); erecting tents over the trenches; and providing improved flooring. When used with other individual and collective protection measures, dozer trenches provide adequate fallout shelters for most situations; they can be provided in a minimum of time and effort. Trenches should not be dug in areas subject to flooding during rain storms. In sandy soil undercutting will not be possible; also some form of support to keep the walls from caving in will be required.

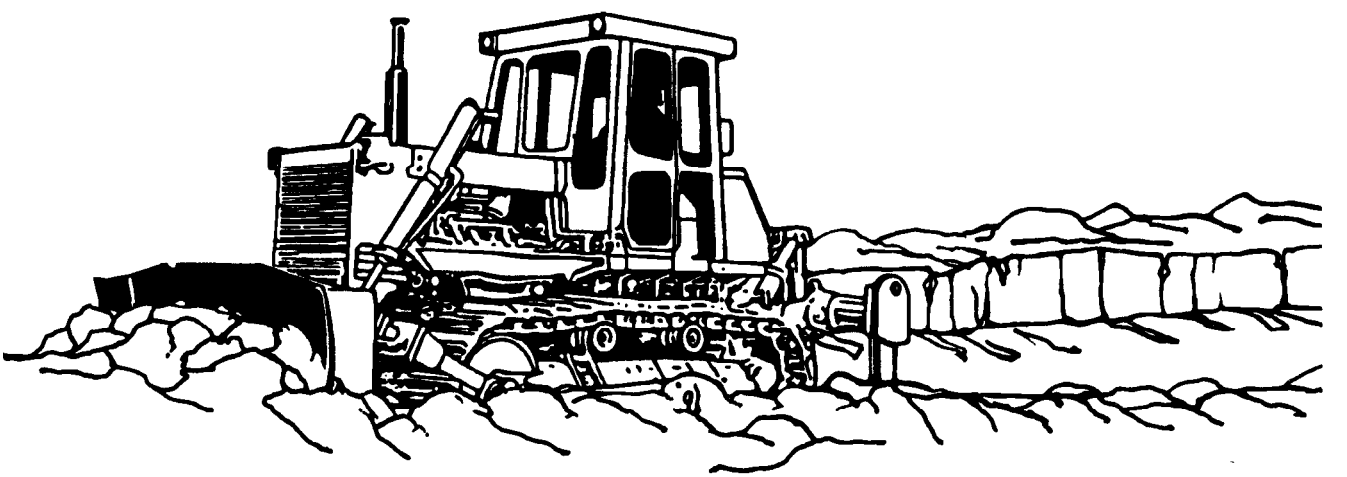

Figure B-2. Dozer trench.

d. Dug-in tents (Figure B-3) for hospitals provide more comfort and require less movement than the dozer trench; however, they have two drawbacks. First, they offer far less radiation protection than the dozer trench, and second, they require considerably more engineer effort.

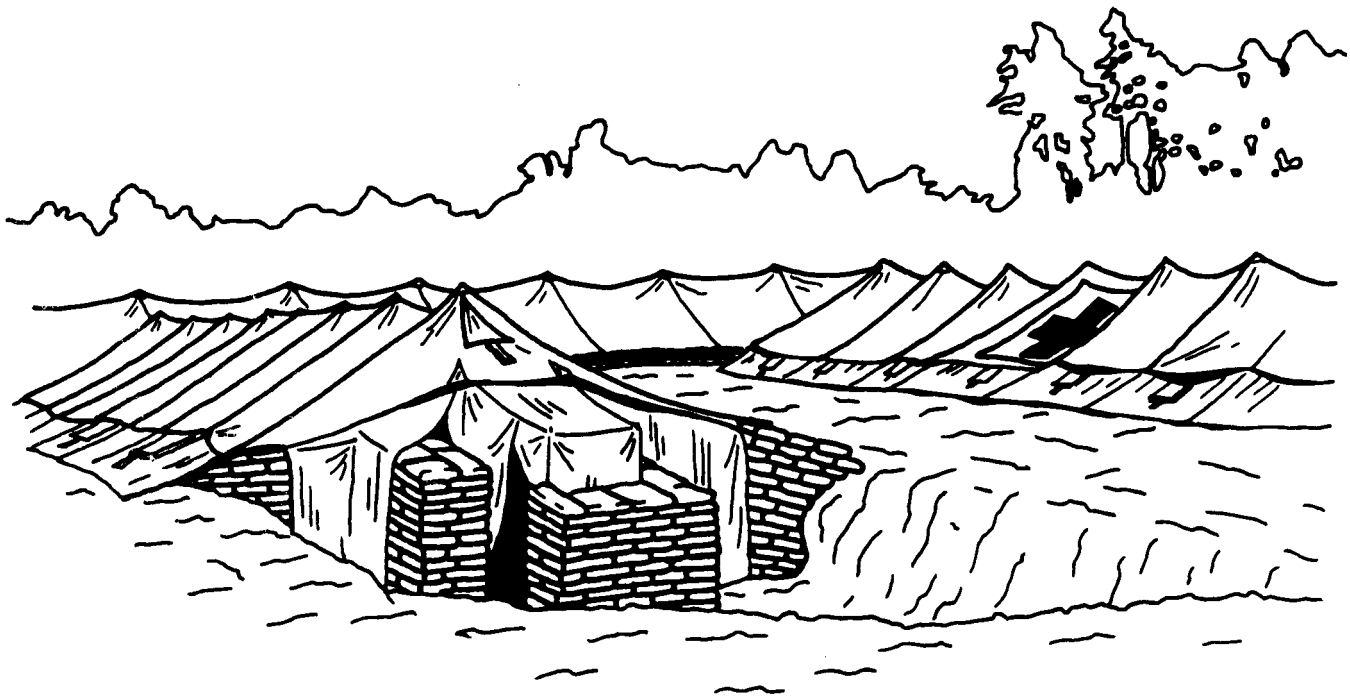

Figure B-3. Dug-in tents.

e. Sandbag walls around the hospital tents as shown in Figure B-4, or lightly constructed buildings provide protection from fallout. Sandbag walls 1.2 meters (4 feet) high give significant protection (20 to 40 percent transmission factor); however, the effort required to achieve the protection is such that it is marginally feasible. Sandbagging is an effective means for supplementing other shelters by—

- Bolstering the shielding at weak points.
- Forming baffles at entryways.
- Blocking open ends of trenches.
- Covering windows and gaps.

f. When other shelters are not available, HSS units must prepare foxholes and trenches for patients and unit personnel. As time permits, these shelters are improved by deepening, covering, undercutting, and sandbagging.

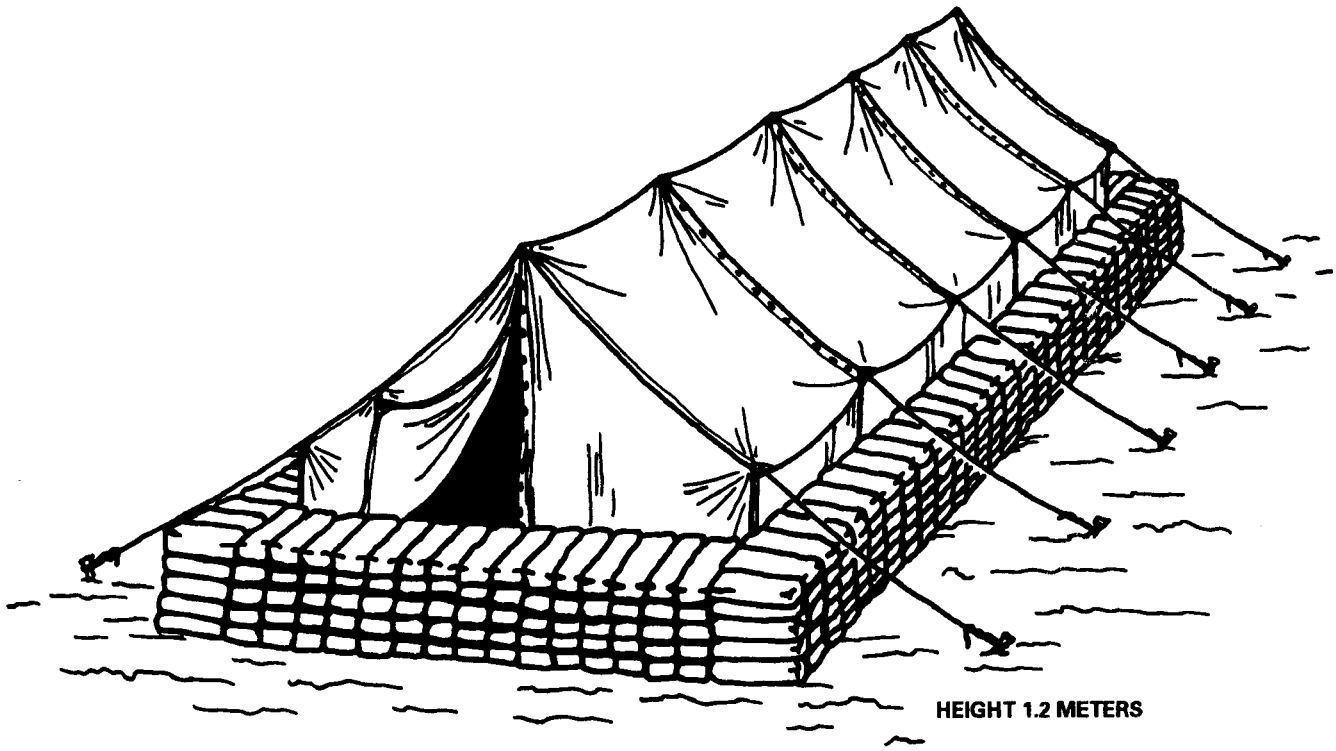

Figure B-4. Sandbag walls around tents.

B-4. Expedient Shelters Against Biological and Chemical Agents

a. When collective protection shelters are not available well sealed shelters (TEMPER, ISO, GP) can significantly minimize or prevent the entry of chemical and biological agents. The ventilation system must be turned off and kept off right before, during and after the attack. The shelter must be totally sealed during this time to maximize protection. Table B-3 provides examples of protection values for well sealed shelters. For example, a well sealed TEMPER tent will only permit 1/60 of the chemical/biological agent outside to enter the shelter. If a persistent agent is used, be aware of the off gassing hazards. Persistent agents can penetrate through TEMPER fabric and create a vapor hazard inside. In a CB agent attack, ensure that all staff and patients are protected.

Table B-3. Ration of Nonpersistent Agent Concentrations (Inside / Outside) for Different Shelters

SHELTER	RATIO INSIDE/OUTSIDE
TEMPER Tent	1:60*
General Purpose Tent Medium With Cotton Liner	1:50
General Purpose Tent Large With Cotton Liner	1:30
ISO Shelter	1:60

*The ventilation system must be turned off on all shelters to provide this level of protection.

b. Sealing shelters to prevent entry of CB agents does not require elaborate materials or procedures.

(1) Material needed for sealing shelters include, but are not limited to the following:

- Duct tape (or similar tape) for sealing.
- Velcro kits for TEMPER tents.
- Sand/dirt to seal base of general purpose tents.
- Plastic sheeting and tape to seal large openings, such as doors to general purpose tents.

(2) Al1 vulnerable areas must be sealed. Seal—

- Joints in IS0 shelters and GP tents with tape. Tape does not work very well on TEMPER fabrics, use Velcro kits.
- Base of GP tents with sand/dirt.
- Stove pipe openings with tape and plastic.
- Windows of GP tent with tape and plastic. Seal TEMPER tent windows by aligning and securing the Velcro border tightly; tape may be applied to the seams to provide some additional barrier.
- All IS0 shelter doors with tape. Seal GP tent doors with plastic sheeting and tape.
- All windows, doors, and other opening of fixed sites with plastic and tape.
- All air ventilation system vents.

NOTE

1. No entry/exit to shelters during a CB attack.
2. In hot climates the heat load will rise in sealed shelters with the ventilation system turned off. Personnel must carefully monitor each other and patients. All personnel must drink plenty of water to prevent heat injuries.

★ APPENDIX C

PATIENT DECONTAMINATION

C-1. General

a. Casualty decontamination presents special problems for units and combat health support (CHS) personnel. Under NBC conditions, contaminated soldiers create increased hazards to rescuers and CHS personnel. Casualty decontamination procedures are performed by each individual, as buddy aid, or at a unit decontamination station prior to the arrival of medical personnel. See FM 3-5 for procedures on individual, buddy aid, and unit decontamination. Patient decontamination procedures are performed at an MTF, under medical supervision.

b. On the NBC battlefield, two classifications of patients will be encountered—contaminated and uncontaminated. Those contaminated may suffer from the effects of an NBC agent, of a conventional wound, or both. Some may suffer combat stress or heat injuries induced by the stress of NBC conditions and extended time spent in MOPP4. It is important to follow proper decontamination procedures to limit the spread of contamination to others and equipment. The most important decontamination is performed at the site of contamination. Decontamination at a later time may be too late to prevent injury to the individual; especially when exposed to vesicants. All agents should be promptly removed from the skin.

This appendix only describes patient decontamination procedures. For treatment procedures, refer to FM 8-9, FM 8-33, and FM 8-285.

C-2. Casualty Decontamination

Casualty decontamination must begin at the platoon and company level with the individual soldier, prior to the arrival of medical personnel. The soldier himself or members of his team must perform immediate decontamination and administer nerve agent antidotes and convulsant antidote for nerve agent (CANA), if required. Enter the time and type of contamination on the field expedient card (Figure C-1) or the DD Form 1380 (Field Medical Card [FMC]). If available, use the CAM or chemical agent detector paper to determine the type of contamination. When the casualty's condition and the battle permits, they may go through a MOPP gear exchange (see Chapter 4, FM 3-5). The MOPP gear exchange must not cause further injury to the casualty. Casualty decontamination differs from patient decontamination in that medical personnel are not available to monitor the patient's medical status nor to provide medical treatment to the individual.

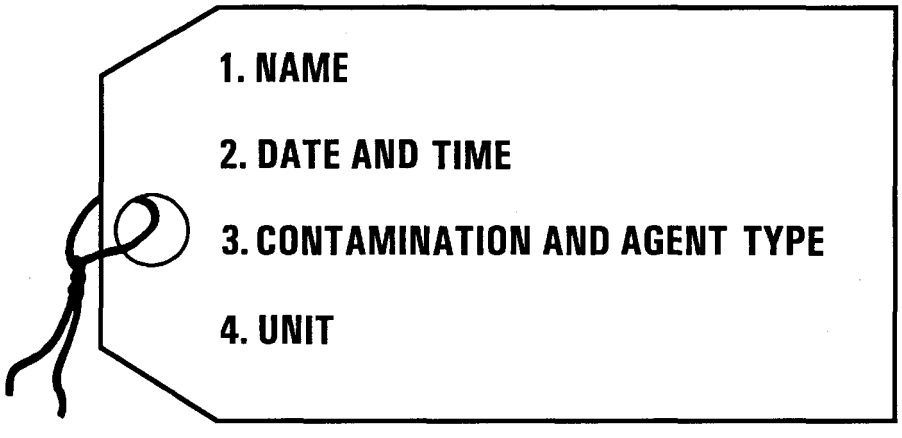

Figure C-1. Field expedient NBC casualty card.

C-3. Patient Decontamination at the Battalion Aid Station

a. When battle conditions prevent casualty decontamination procedures forward or the patient is contaminated en route, the patient may have to be decontaminated at the battalion aid station (BAS). Contaminated patients arriving at the BAS must be decontaminated before admission into the clean treatment area.

b. Patient decontamination is the systematic removal of clothing and contaminants from patients who are unable to decontaminate themselves. Patient decontamination is performed by a patient decontamination team consisting of a minimum of eight (8) nonmedical personnel from the supported unit at the BAS. The patient decontamination team operates under the supervision of medical personnel to ensure that no further injury is caused to the patient by the decontamination process.

C-4. Patient Decontamination at the Medical Company Clearing Station

The medical company clearing station may receive patients from the BAS or directly from other areas who have not been decontaminated. The clearing station must also have a patient decontamination area. As with the BAS, the clearing station must have a minimum of eight nonmedical personnel from the supported units to perform patient decontamination. Procedures for patient decontamination at the clearing station are the same as for the BAS.

C-5. Patient Decontamination at a Hospital

a. To the maximum extent possible, hospitals are located away from tactical or logistical targets. Patients evacuated from forward areas should have been decontaminated; however, patients may arrive from forward MTFs and units located within the geographical area of the hospital that are contaminated and require decontamination. Patient decontamination is done by at least 20 nonmedical personnel from units located in the geographical area/base cluster of the hospital.

b. If the hospital does not have a collective protective shelter (CPS) system and becomes contaminated with a persistent agent, patients are rerouted to other hospitals. If possible, all inpatients are evacuated and the hospital decontaminated.

c. Upon completion of decontamination, the hospital will return to normal operations. Hospitals with CPS systems will decontaminate areas around the entry to these facilities, then continue receiving and caring for patients. Patient decontamination procedures used in forward medical facilities also apply to hospital operations. However, several patient decontamination stations can be operated at the hospital patient decontamination site. All patients arriving at the hospital from suspect contaminated areas or crossing contaminated areas will be considered as being contaminated. They must be decontaminated before being admitted into the clean areas of the hospital. Perform decontamination as required.

C-6. Prepare Chlorine Solutions for Patient Decontamination

The standard skin decontaminating kit is the M291. The M258A1 skin decontamination kit is being replaced by the M291; however, the M258A1 kit may be used until the M291 kits have been issued.

Upon receipt of the M291 kits, the M258A1 kit should only be used for decontamination of individual equipment. An alternative patient decontamination agent is a chlorine solution; however, the chlorine solution must be prepared. Two concentrations of the chlorine solution are required. A 5 percent chlorine solution to decontaminate gloves, aprons, litters, cutting device, the patient's mask hood, and other nonskin contact areas. A 0.5 (½) percent chlorine solution to decontaminate the patient's mask, skin, splints, and to irrigate wounds. To prepare the solutions, calcium hypochlorite (HTH) granules (supplied in 6-ounce jars in the chemical agent patient treatment and decontamination medical equipment sets), bulk HTH, or sodium hypochlorite (household bleach) may be used. Prepare the required concentrations as shown in Table C-1 below.

Table C-1. Preparation of Chlorine Solution for Patient Decontamination

HTH OUNCES	HTH MRE SPOONFULS	HOUSEHOLD BLEACH	PERCENT IN 5 GALLONS OF WATER
6	*5	2 quarts	0.5
48	40	**	5.0

* These measurements are used when bulk HTH is used. To measure this preparation, use the plastic spoon supplied with your meal, ready-to-eat (MRE). The amount of chlorine to be used is a heaping spoonful (that is, all that the spoon will hold). Do not shake any granules off of the spoon before adding to the water.

** Do not dilute in water; household bleach is approximately 5 percent solution.

CAUTIONS

1. Do not use the 5 percent chlorine solution on the patient's skin.

2. Only wipe the skin when applying the 0.5 percent chlorine solution. Vigorous scrubbing may force the agent into the skin.

C-7. Decontaminate a Litter Chemical Agent Patient

Before contaminated patients receive medical treatment in the clean treatment area, they are decontaminated by the patient decontamination team. Place the cutting device in a container of 5 percent chlorine solution between each use. Each decontamination team member decontaminates his gloves and apron with the 5 percent chlorine solution frequently to prevent spreading any contamination to patient's skin.

NOTE

Litter patients requiring EMT or ATM treatment in the clean area of the MTF will be completely decontaminated. A patient not requiring clean EMT or ATM at the MTF, but requiring further evacuation (Example: A stable patient with a partial amputation of a lower extremity) should only have his wound area and MOPP spot decontaminated to remove any gross contamination. The patient should be evacuated in his MOPP.

Decontaminate the patient's skin, bandages, wounds, mask, identification tags with chain, and splints with a 0.5 percent chlorine solution. The litter patient is decontaminated and undressed as follows:

a. **Step 1. Decontaminate the patient's mask and hood.** Move the patient to the clothing removal station. After the patient has been triaged and stabilized (if necessary) by the senior medic in the patient decontamination area, move him to the litter stands at the clothing removal station.

(1) **Decontaminate the mask and hood.** Use the M291 kit, or sponge down the front, sides, and top of the mask hood with a 5 percent chlorine solution or household bleach.

(2) **Remove hood.** Remove the hood by cutting the hood (see Figure C-2) or by loosening the hood from the mask attachment points for the quick-doff hood or other similar hoods. Before cutting the hood, dip the cutting device in a 5 percent chlorine solution. Cut the neck cord and the small string under the voicemitter. Release or cut the hood shoulder straps and unzip the hood zipper. Cut the hood upward, close to the filter inlet cover and eye-lens outsert, upward to the top of the eye-lens outsert, and across the forehead to the outer edge of the other eye-lens outsert. Proceed downward toward the patient's shoulder, staying close to the eye-lens and filter inlet cover, then across the lower part of the voicemitter to the zipper. After dipping the cutting device in the 5 percent chlorine solution, cut the hood from the center of the forehead over the top of the head and fold the left and right sides of the hood to the side of the patient's head, laying the sides of the hood on the litter.

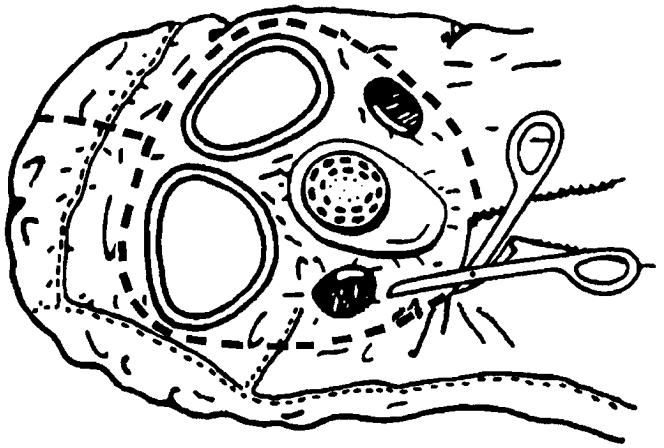

Figure C-2. Cutting the protective mask hood.

(3) **Decontaminate the protective mask and exposed skin.** Using the M291 kit, or a 0.5 percent chlorine solution, wipe the external parts of the mask. Cover the mask air inlets with gauze or your hand to keep the mask filter dry. Continue by wiping the exposed areas of the patients face, to include the neck and behind the ears.

(4) **Remove the Field Medical Card.** Cut the patient's FMC tie wire, allowing the FMC to fall into a plastic bag. Seal the plastic bag and rinse the outside of the bag with a 5 percent chlorine solution. Place the plastic bag with the FMC under the back of the protective mask head straps. The FMC will remain with the patient in the contaminated area and a clean copy will be made before the patient is moved to the clean area.

b. **Step 2. Remove gross contamination from the patient's overgarment.** Remove all visible gross contamination by scraping with a stick or other scraping device. Decontaminate spots with the M295 kit (preferred method), M291 kit, or the 5 percent chlorine solution.

c. **Step 3. Remove the patient's personal effects and protective overgarment.**

(1) **Remove patient's personal effects.** Remove the patient's personal effects from his protective overgarment and BDU pockets. Place the articles in a plastic bag, label with the patient's identification, and seal the bag. If the articles are not contaminated, they are returned to the patient. If the articles are contaminated, place them in the contaminated holding area until they can be decontaminated, then return them to the patient.

(2) **Cut the patient's overgarment.** The overgarment jacket and trousers may be cut simultaneously. Two persons may be cutting clothing at the same time. Cut around bandages, tourniquets, and splints, leaving them in place.

NOTE

A cut is a separation of material by use of a cutting device that separates material into two pieces. EXAMPLE: Cutting the sleeve from the cuff to the jacket collar is one cut.

CAUTION

Bandages may have been applied to control severe bleeding and are treated like tourniquets. Only medical personnel remove bandages, tourniquets, and splints.

(3) **Remove overgarment jacket.** Make two cuts, one up each sleeve from the wrist up to the shoulder, and then through the collar (Figure C-3). Do not allow the gloves to touch the patient along the cut line. Dip the cutting device in the 5 percent chlorine solution before making each cut to prevent contamination of the patient's uniform or underclothing. Keep the cuts close to the inside of the arms so that most of the sleeve material can be folded outward. Unzip the jacket; roll the chest sections to the respective sides, with the inner surface outward. Continue by tucking the clothing between the arm and chest. Roll the cut sleeves away from the arms, exposing the black liner.

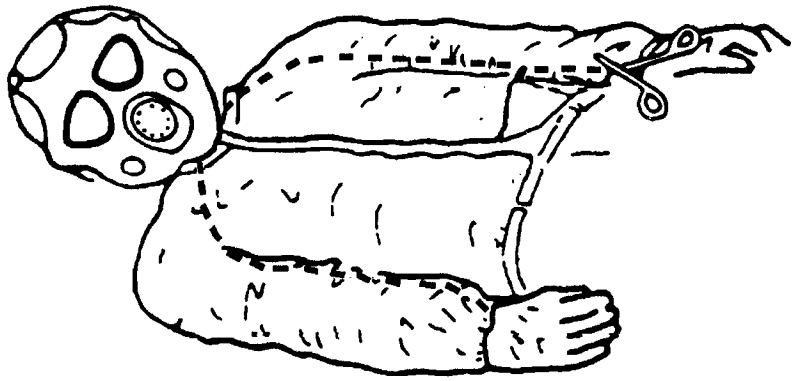

Figure C-3. Cutting the overgarment jacket.

(4) **Remove overgarment trousers.** Cut both trouser legs starting at the ankle as shown in Figure C-4. Keep the cuts near the inseams to the crotch. With the left leg, continue cutting to the waist, avoiding the pockets. With the right leg, cut across at the crotch to the left leg cut. Place the cutting device in the 5 percent chlorine solution. Fold the cut trouser halves away from the patient and allow the halves to drop to the litter with contaminated (green) side down. Roll the inner leg portion under and between the legs.

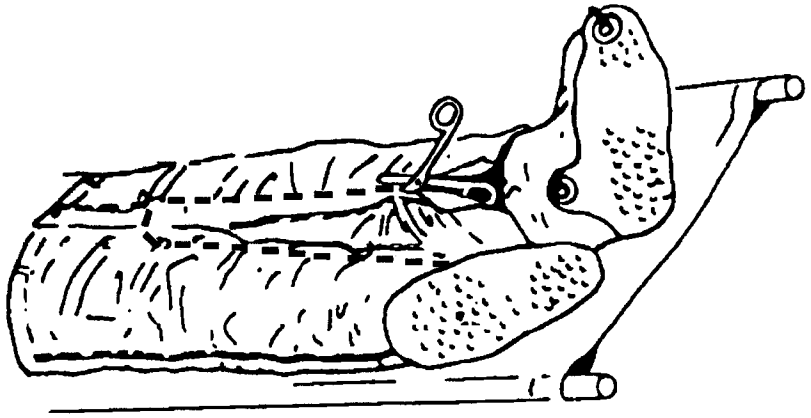

Figure C-4. Cutting the overgarment trousers.

(5) **Remove outer gloves.** This procedure can be done with one person on each side of the patient working simultaneously. The decontamination team will decontaminate their gloves in 5 percent chlorine solution. Next, lift the patient's arms up and out of the cutaway sleeves unless detrimental to the patient's condition. Grasp the fingers of the glove, roll the cuff over the fingers, turning the glove inside out. Do not remove the inner cotton glove liners at this time. Carefully lower the arms across the chest after the outer gloves have been removed (Figure C-5). Do not allow the patient's arms to come into contact with the exterior of his overgarment. Drop his gloves into the contaminated waste bag. Dip your gloves in the 5 percent chlorine solution.

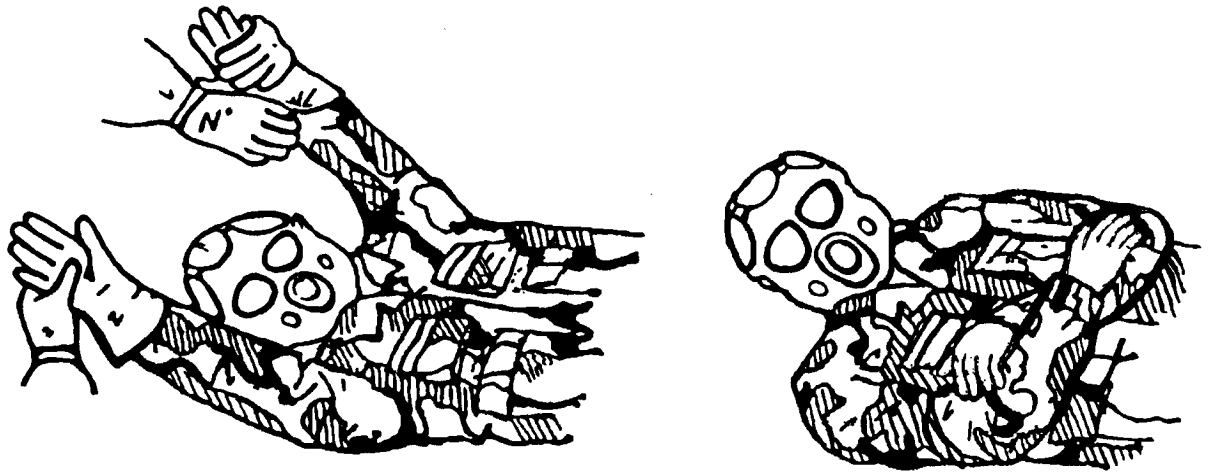

Figure C-5. Remove outer gloves and position arms after glove removal.

(6) **Remove overboots.** Cut the overboot laces and fold the lacing eyelets flat outwards. If the GVO is worn, first try to remove the overboot without cutting; if necessary, cut the boot along the front. While standing at the foot of the litter, hold the heel with one hand, pull the overboot downwards, then pull towards you to remove the overboot over the combat boot heel. Remove the two overboots simultaneously. This reduces the likelihood of contaminating one of the combat boots. While holding the heels off the litter, have a decontamination team member wipe the end of the litter with the 5 percent chlorine solution to neutralize any liquid contamination that was transferred to the litter from the overboots. Lower the patient's heels onto the decontaminated litter. Place the overboots in the contaminated waste bag. Decontamination personnel dip their gloves in the 5 percent chlorine solution.

d. **Step 4. Remove patient's battledress uniform.**

(1) **Remove battledress uniform.** Cut the BDU jacket and trousers as described above for the protective overgarment. Roll the jacket and trousers as described for the protective overgarment.

(2) **Remove combat boots.** Cut the boot laces along the tongue. Remove the boots by pulling them towards you. Place the boots in the contaminated waste bag. Do not touch the patient's skin with contaminated gloves when removing his boots.

(3) **Remove undergarments.** Follow the procedures for cutting away the protective overgarment and rolling it away from the patient. If the patient is wearing a brassiere, cut it between the cups. Cut both shoulder straps where they attach to the cups and lay them back off of the shoulders. Remove the socks and cotton glove liners. Do not remove the patient's identification tags.

e. **Step 5. Transfer the patient to a decontamination litter.** After the patient's clothing has been cut away, he is transferred to a decontamination litter or a canvas litter with a plastic sheeting cover. Three decontamination team members decontaminate their gloves and aprons with the

5 percent chlorine solution. One member places his hands under the patient's legs at the thighs and Achilles tendons, a second member places his arms under the patient's back and buttocks, and a third member places his arms under the patient's shoulders and supports the head and neck. They carefully lift the patient using their knees (not their backs) to minimize back strain. While the patient is elevated, another decontamination team member removes the litter from the litter stands and replaces it with a decontaminated (clean) litter. The patient is carefully lowered onto the clean litter. The contaminated clothing and overgarments are placed in bags and moved to the contaminated waste dump. The dirty litter is rinsed with the 5 percent chlorine solution and placed in the litter storage area.

f. **Step 6. Decontaminate skin.**

(1) **Spot decontamination.** With the patient in a supine position, spot decontaminate the skin using the M291 kit or a 0.5 percent chlorine solution. Decontaminate areas of potential contamination. Include areas around the neck, wrists, and lower parts of the face. Decontaminate the patient's identification tags and chain, if necessary.

NOTE

Complete body wash is not appropriate and may be injurious to the patient. During complete body wash the patient would have to be rolled over to reach all areas of the skin. This is not necessary for adequate decontamination.

(2) **Combat medic care.** During decontamination, the clothing around bandages, tourniquets, and splints was cut and left in place.

- The combat medic replaces the old tourniquet by placing a new tourniquet ½ to 1 inch above the old one. He then removes the old tourniquet and decontaminates the patient's skin using the M291 pads or a 0.5 percent chlorine solution.

- Usually, the combat medic will gently cut away bandages. The combat medic decontaminates the area around the wound; dusts the wound with the M291 kit, or irrigates soft tissue wounds with the 0.5 percent chlorine solution. If bleeding begins, the combat medic replaces the bandage with a clean one.

WARNINGS

1. DO NOT APPLY THE M291 KIT OR IRRIGATE WOUNDS IN THE ABDOMINAL AND THORACIC CAVITIES OR INTRACRANIAL HEAD INJURIES.

2. DO NOT USE THE WIPES FROM THE M258A1 KIT AROUND ANY WOUNDS.

3. DO NOT REMOVE SPLINTS.

- The combat medic ensures splints are not removed, but are decontaminated in place by applying the 0.5 percent chlorine solution to them, to include the padding and cravats. Splints will only be removed by a physician or under the supervision of a physician.

(3) **Check patient for completeness of decontamination.** The patient is checked with the CAM or with M8 detector paper for completeness of decontamination.

NOTE

Other monitoring devices may be used when available.

(4) **Dispose of contaminated waste.** Dispose of contaminated bandages and coverings by placing them in a contaminated waste bag. Seal the bag and place it in the contaminated waste dump.

g. **Step 7. Transfer the patient across the shuffle pit.**

(1) The patient's clothing has been cut away and his skin, bandages, and splints have been decontaminated. Now the litter is transferred to the shuffle pit and placed upon the litter stands. The shuffle pit is wide enough to prevent the patient decontamination team members from straddling it while carrying the litter. Four decontamination team members transfer the patient to a clean treatment litter in the shuffle pit.

(2) Decontamination personnel rinse or wipe down their aprons and gloves with the 5 percent chlorine solution.

(3) Three decontamination team members lift the patient off the decontamination litter (see Step 5 for lifting procedures).

(4) While the patient is elevated, another decontamination team member removes the litter from the stands and returns it to the decontamination area. A medic from the clean side of the shuffle pit replaces the litter with a clean one. The patient is lowered onto the clean litter. Two medics from the clean side of the shuffle pit move the patient to the clean treatment area. The patient is treated in this area or awaits processing into the CPS. The litter removed by the decontamination team member is wiped down with the 5 percent chlorine solution in preparation for reuse. Once the patient is in the air lock of the CPS and the air lock has been purged, his protective mask is removed by a medic in the CPS. Place the mask in a plastic bag, close, and seal the bag.

NOTE

Before decontaminating another patient, each decontamination team member drinks approximately one-half quart of water. The exact amount of water consumed is increased or decreased according to the work level and temperature (see Table C-2 below).

Table C-2. Heat Injury Prevention and Water Consumption.

*CRITERIA		CONTROLS		
HEAT CONDITION/ CATEGORY	WBGT INDEX F°	WATER INTAKE QUART/HOUR	PHYSICAL ACTIVITY FOR SOLDIERS **ACCLIMATIZED WORK/REST	UNACCLIMATIZED SOLDIERS AND TRAINEES
White/1	78-81.9	At least ½	Continuous	
Green/2	82-84.9	At least ½	50/10 minutes	Use discretion in planning heavy exercise.
Yellow/3	85-87.9	At least 1	45/15 minutes	Suspend strenuous exercise during first three weeks of training. Training activities may be continued on a reduced scale after the second week of training. Avoid activity in direct sun.
Red/4	88-89.9	At least 1½	30/30 minutes	Curtail strenuous exercise for all personnel with less than 12 weeks of hot weather training.
Black/5	90 and up	More than 2	20/40 minutes	Physical training and strenuous exercise is suspended. Essential operational commitments not for training, where risk of heat casualties may be warranted, are excluded from suspension. Enforce water intake to minimize expected heat injuries.

* MOPP gear or body armor adds 10°F to the WBGT index. EXAMPLE: WBGT 88°F + 10°F = 98°F.
** An acclimatized soldier is one who has worked in the given heat condition for 10 to 14 days.

NOTE: "Rest" means minimal physical activity. Rest should be accomplished in the shade if possible. Any activity requiring only minimal physical activity can be performed during "rest" periods. EXAMPLES: Training by lecture or demonstration, minor maintenance procedures on vehicles or weapons, and personal hygiene activities such as skin and foot care.

C-8. Decontaminate an Ambulatory Chemical Agent Patient

All ambulatory patients requiring EMT or ATM in the clean area of the BAS will be decontaminated. Stable patients not requiring treatment at the BAS, but requiring evacuation to the medical company

clearing station or a corps hospital for treatment (Example: A patient with a broken arm) should be evacuated in their protective overgarments and masks by any available transportation. However, before evacuation, spot remove all thickened agents from protective clothing. A member of the decontamination team or other ambulatory patients will assist the patient in removing his clothing and decontaminating his skin.

NOTES

1. Remember, do not remove clothing from an ambulatory patient unless he requires treatment in the clean treatment area of the BAS or clearing station. Only spot decontaminate the patient's clothing and evacuate him to the next echelon of care.

2. Place cutting device used in this procedure in a container of 5 percent chlorine solution when not in use. Most ambulatory patients will be treated in the contaminated treatment area and returned to duty. Upon removal of an ambulatory patient's clothing, he becomes a litter patient. The BAS and clearing station do not have clothing to replace those cut off during the decontamination process. The patient must be placed in a patient protective wrap (PPW) for protection during evacuation (Figure C-6).

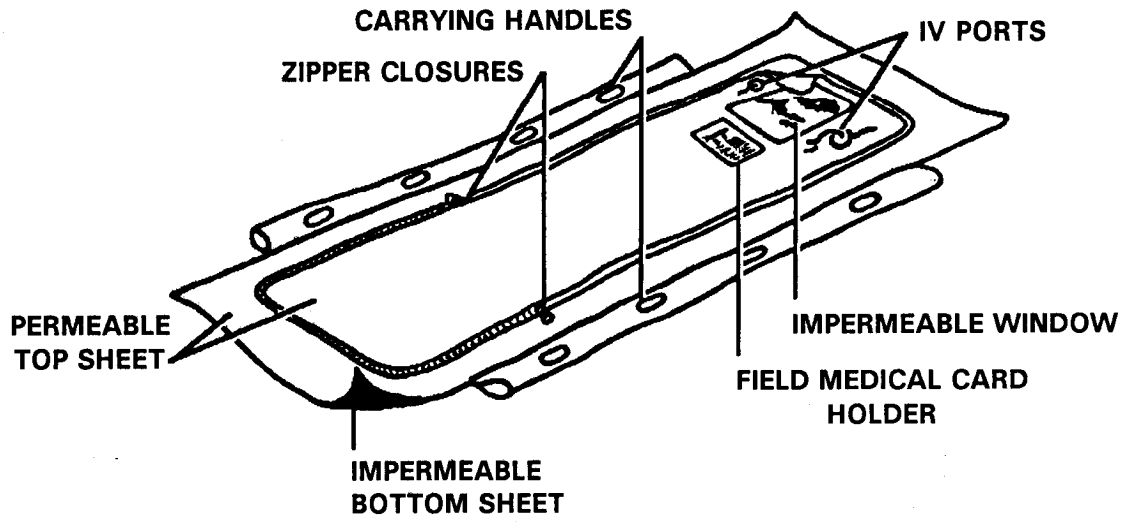

Figure C-6. Chemical warfare agent protective patient wrap.

a. **Step 1. Remove load-carrying equipment.** Remove load-carrying equipment (LCE) by unfastening/unbuttoning all connectors or tie straps; then place the equipment in a plastic bag. Place the plastic bag in the designated storage area for later decontamination.

b. **Step 2. Decontaminate the patient's mask and hood.** After the patient has been triaged and treated (if necessary) by the senior medic in the patient decontamination station, the patient (assisted by another ambulatory patient or a member of the patient decontamination team, if necessary) begins the clothing removal process.

(1) **Decontaminate and remove mask hood.** Sponge down the front, sides, and top of the hood with a 5 percent chlorine solution. Remove the hood by cutting (Figure C-2) or, with the quick-doff hood or other hoods, by loosening the hood from the mask attachment points. Before cutting the hood, dip the cutting device in the 5 percent chlorine solution. Begin by cutting the neck cord and the small string under the voicemitter. Next, release or cut the hood shoulder straps and unzip the hood zipper. Proceed by cutting the hood upward, close to the filter inlet cover and eye-lens outserts, to the top of the eye-lens outsert, across the forehead to the outer edge of the other eye-lens outsert. Proceed downward toward the patient's shoulder, staying close to the eye-lens and filter inlet. Cut across the lower part of the voicemitter to the zipper. After dipping the cutting device in the 5 percent chlorine solution again, cut the hood from the center of the forehead over the top of the head and fold the right and left sides of the hood away from the patient's head, removing the hood.

(2) **Decontaminate the mask and patient's face.** Decontaminate the mask and the patient's face by using the M291 kit or a 0.5 percent chlorine solution. Wipe the external parts of the mask; cover both mask air inlets with gauze or your hands to keep the mask filters dry. Continue by wiping the exposed areas of the patient's face, to include the neck and behind the ears.

c. **Step 3. Remove Field Medical Card.** Cut the FMC tie wire, allowing the card to fall into a plastic bag. Seal the plastic bag and rinse it with the 5 percent chlorine solution. Place the plastic bag under the back of the protective mask head straps.

d. **Step 4. Remove all gross contamination from the patient's overgarment.** Remove all visible contamination spots by using the M295 kit (preferred method), M291 kit, or a sponge dipped in a 5 percent chlorine solution.

e. **Step 5. Remove overgarments.**

(1) **Remove the patient's personal effects.** Place the patient's personal effects in a clean bag and label with the patient's identification. If they are not contaminated, give them to him. If his personal effects are contaminated, place the bagged items in the contaminated storage area until the y can be decontaminated, then return them to the patient.

(2) **Remove overgarment jacket.** Have the patient stand with his feet spread apart at shoulder width. Unsnap the jacket front flap and unzip the jacket. If the patient can extend his arms, have him clinch his fist and extend his arms backward at about a 30° angle. Move behind the patient, grasping his jacket collar at the sides of the neck, peel the jacket off the shoulders at a 30° angle down and away from the patient. Avoid any rapid or sharp jerks which spread contamination. Gently pull the inside sleeves over the patient's wrists and hands. If the patient cannot extend his arms, you must cut the jacket to aid in its removal. Dip the cutting device in the 5 percent chlorine solution between each cut. As with the litter patient, cut both sleeves from the inside, starting at the wrist, up to the armpit. Continue cutting across the shoulder to the collar. Cut around bandages or

splints, leaving them in place. Next, peel the jacket back and downward to avoid spreading contamination. Ensure that the outside of the jacket does not touch the patient or his inner clothing.

(3) **Remove overgarment trousers.** Unfasten or cut all ties, buttons, or zippers before grasping the trousers at the waist and peeling them down over the patient's combat boots. Again, the trousers are cut to aid in removal. If necessary, cut both trouser legs starting at the ankle, keeping the cuts near the inside of the legs, along the inseam, to the crotch. Cut around all bandages, tourniquets, or splints. Continue to cutup both sides of the zipper to the waist and allow the narrow strip with the zipper to drop between the legs. Place the cutting device in the 5 percent chlorine solution. Peel or allow the trouser halves to drop to the ground. Have the patient step out of the trouser legs, one at a time. Place the trousers in the contaminated disposal bag.

(4) **Remove overboots.** Remove the patient's overboots by cutting the laces with cutting device dipped in the 5 percent chlorine solution. Fold the lacing eyelets flat on the ground. Step on the toe and heel eyelets to hold the overboot on the ground and have the patient step out of it. Repeat this procedure for the other overboot. If the GVO is worn, first try to remove the overboots without cutting; if necessary, cut the overboot along the front. If the overboots are in good condition, they can be decontaminated and reissued.

(5) **Remove the patient's outer gloves.** Grasp the heel of the glove, peel the glove off with a smooth downward motion. Place the contaminated gloves in a plastic bag with the overgarment jacket. Do not allow the patient to touch his clothing or other contaminated objects with his exposed hands.

(6) **Remove the patient's cotton glove liners.** Have the patient remove his cotton glove liners to reduce the possibility of spreading contamination. Have the patient grasp the heel of one glove liner with the other gloved hand, peeling it off of his hand. Hold the removed glove by the inside and grasp the heel of the other glove, peeling it off of his hand. Place both glove inserts in the contaminated waste bag.

f. **Step 6. Check patient for contamination.** After the patient's overgarments have been removed, check his BDU by using M8 detector paper or the CAM. Carefully survey all areas of the patient's clothing, paying particular attention to discolored areas on the uniform, damp spots, tears, areas around the neck, wrist, ears, and dressings, splints, or tourniquets. Remove contaminated spots by using the 0.5 percent chlorine solution, using the M291 kit, or cutting away the contaminated area. Always dip the cutting device in the 5 percent chlorine solution after each cut. Recheck the area with the detection equipment. If significant contamination is found on the BDU, then the BDU must be removed and the skin spot decontaminated. Follow procedures for removal of the overgarment in removing the BDU. Do not remove the patient's identification tags.

g. **Step 7. Decontaminate skin.**

(1) **Spot decontamination.** Use the M291 kit or the 0.5 percent chlorine solution to spot decontaminate exposed neck and wrist areas, splints, other areas where the protective overgarment was damaged, and where dressings or bandages were removed. Decontaminate the patient's identification tags, if necessary. Have the patient hold his breath and close his eyes. Have him, or assist him, lift his mask at the chin. Wipe his face with the M291 pad or the 0.5 percent chlorine solution. Wipe quickly from below the top of one ear, being careful to wipe all folds of the skin, top of the upper lip, chin, dimples, ear lobes, and nose. Continue up the other side of the face to the top of the other ear. Wipe the inside of the mask where it touches the face. Have the patient reseal and check his mask.

CAUTION

Keep the decontamination solution out of the patient's eyes.

(2) **Combat medic care.** During clothing removal, the clothing around bandages, tourniquets, and splints was cut and left in place.

- The combat medic replaces the old tourniquet by placing a new one ½ to 1 inch above the old tourniquet. When the old tourniquet is removed, the skin is decontaminated with the M291 kit or the 0.5 percent chlorine solution.

- *Do not remove splints.* Decontaminate them by thoroughly rinsing the splint, padding, and cravats with the 0.5 percent chlorine solution.

- Usually, the combat medic will gently cut away bandages. The area around the wound is dusted with the M291 pad or rinsed with the 0.5 percent chlorine solution. and the combat medic applies the M291 pad or irrigates the soft tissue wound with the 0.5 percent chlorine solution. If bleeding begins, the combat medic replaces the bandage with a clean one.

h. **Step 8. Dispose of contaminated waste.** Dispose of contaminated bandages and coverings by placing them in a plastic bag and sealing the bag with tape. Place the plastic bags in the contaminated waste dump.

i. **Step 9. Proceed through the shuffle pit to the clean treatment area.** Have the decontaminated patient proceed through the shuffle pit to the clean treatment area. Make sure that the patient's boots are thoroughly decontaminated by stirring the contents of the shuffle pit with his boots as he crosses it. The patient will remove his combat boots and protective mask in the entrance of the CPS or clean treatment area.

C9. Biological Patient Decontamination Procedures

The decontamination station as established for chemical agent patients is also used for biologically contaminated patients. The 8-man patient decontamination team is required for biologically contaminated patient decontamination procedures.

C-10. Decontaminate a Litter Biological Agent Patient

a. **Remove the patient's personal effects.** Place the patient's personal effects in a clean bag and label with the patient's identification. If they are not contaminated, give them to him. If his personal effects are contaminated, place the bagged items in the contaminated storage area until they can be decontaminated, then return them to the patient.

b. **Remove the Field Medical Card.** Remove the FMC by cutting the tie wire and allowing the FMC to drop into a plastic bag. Keep the FMC with the patient.

c. **Remove the patient's clothing.** Patient decontamination team members first apply the 5 percent chlorine solution to the patient's clothing and the litter. Then, remove the patient's

clothing as in decontamination of chemical agent patients. Bandages, tourniquets, and splints are not removed. Move patient to a clean litter as described for a chemical agent patient. Place patient's clothing in a plastic bag and dispose in the contaminated waste dump.

d. **Decontaminate the patient's skin.** Bathe the patient with soap and warm water or apply the 0.5 percent chlorine solution. The combat medic places a new tourniquet ½ to 1 inch above the old tourniquet, then he removes the old one. The combat medic removes bandages and decontaminates the skin and wound with the 0.5 percent chlorine solution; he replaces the bandage, if needed, to control hemorrhage. Splints are disinfected by soaking the splint, cravats, and straps with the 0.5 percent chlorine solution.

NOTE

Use a 0.5 percent chlorine solution to decontaminate ambulatory patients suspected of being contaminated with mycotoxins.

e. **Transfer patient to hotline.** Two decontamination team members move patient to the hotline. Request assistance from two other decontamination team members to transfer him to a clean litter as described for chemical agent patients. Place the patient's FMC in the plastic bag on the clean litter with him. Two medics from the clean side of the hotline move the patient from the hotline to the clean treatment/holding area.

C-11. Decontaminate an Ambulatory Biological Agent Patient

a. **Remove the patient's personal effects.** Place the patient's personal effects in a clean bag and label with the patient's identification. If they are not contaminated, give them to him. If his personal effects are contaminated, place the bagged items in the contaminated storage area until they can be decontaminated, then return them to the patient.

b. **Remove the Field Medical Card.** Remove the FMC by cutting the tie wire and allowing the FMC to drop into a plastic bag. Keep the FMC with the patient.

c. **Remove the patient's clothing.** Patient decontamination team members first apply the 5 percent chlorine solution to the patient's clothing. Then remove the patient's clothing as in decontamination of chemical agent patients. Bandages, tourniquets, and splints are not removed. Place patient's clothing in a plastic bag and dispose in the contaminated waste dump.

d. **Decontaminate the patient's skin.** Have the patient bathe with soap and warm water or apply the 0.5 percent chlorine solution. If the patient is unable to bathe himself, a member of the decontamination team must bathe him. The combat medic places a new tourniquet ½ to 1 inch above the old tourniquet, then he removes the old one. The combat medic removes bandages and decontaminates the skin and wound with the 0.5 percent chlorine solution; he replaces the bandage, if needed, to control hemorrhage. Splints are disinfected by soaking the splint, cravats, and straps with the 0.5 percent chlorine solution.

NOTE

Use a 0.5 percent chlorine solution to decontaminate ambulatory patients suspected of being contaminated with mycotoxins.

e. **Direct patient across hotline.** Direct the patient to cross the hotline to the clean treatment area. His boots must be decontaminated at the hotline before he enters the clean treatment area.

NOTES

1. Remember, do not remove clothing from an ambulatory patient unless he requires treatment in the clean treatment area of the BAS or clearing station. Only spot decontaminate the patient's clothing and evacuate him to the next echelon of care.

2. Place cutting device used in this procedure in a container of 5 percent chlorine solution when not in use. Most ambulatory patients will be treated in the contaminated treatment area and returned to duty. Upon removal of an ambulatory patient's clothing, he becomes a litter patient. The BAS and clearing station do not have clothing to replace those cut off during the decontamination process. The patient must be placed in a patient protective wrap (PPW) for protection during evacuation (Figure C-6).

C-12. Decontaminate Nuclear-Contaminated Patients

The practical decontamination of nuclear-contaminated patients is easily accomplished without interfering with the required medical care.

NOTE

Patients must be monitored by using a radiac meter (AN/VDR2, AN/PDR27, or AN/PDR77) before, during, and after each step of the decontamination procedure.

C-13. Decontaminate a Litter Nuclear-Contaminated Patient

a. **Remove patient's personal effects.** Patient decontamination team members remove the patient's personal effects and place them in a plastic bag. Place plastic bag in a clean holding area.

b. **Remove patient's clothing.** Patient decontamination team members remove the patient's outer clothing as described for chemical agent patients. Do not remove bandages, tourniquets,

or splints. Move the patient to a clean litter. Place the patient's contaminated clothing in a plastic bag and move the bagged clothing to the contaminated waste dump.

NOTE

Patients arriving at the MTF in MOPP will only have their MOPP removed. They can remain in their BDU unless contamination is found on it.

c. **Spot decontaminate patient's skin.** Wash exposed skin surfaces with soap and warm water. Wash the hair with soap and warm water, or clip the hair and wash the scalp with soap and warm water.

d. **Transfer patient to hotline.** Move the patient to the hotline. Two medics from the clean side of the hotline move the patient into the clean treatment area.

C-14. Decontaminate an Ambulatory Nuclear-Contaminated Patient

a. **Remove patient's personal effects.** Have the patient remove his personal effects and place them in a plastic bag.

b. **Remove patient's outer clothing.** Have the patient remove his outer clothing (or have a decontamination team member assist him). Place his contaminated clothing in a plastic bag and move the bagged clothing to the contaminated waste dump.

NOTE

Patients arriving at the MTF in MOPP will only have their MOPP removed. They can remain ambulatory in their BDU unless contamination is found on it.

c. **Spot decontaminate patient's skin.** Have the patient wash his exposed skin surfaces with soap and warm water. Wash his hair with soap and water, or clip the hair and wash the scalp with soap and water.

d. **Transfer patient to hotline.** Direct the patient to move to the hotline. Decontaminate his boots by stirring the shuffle pit contents with his feet before he crosses into the clean treatment area.

NOTE

If a new protective overgarment is not available, he must be placed in a PPW. Thus, he becomes a litter patient for evacuation.

APPENDIX D

EMPLOYMENT OF CHEMICAL AND BIOLOGICAL COLLECTIVE PROTECTION SHELTER SYSTEMS BY MEDICAL UNITS

D-1. Types of Collective Protection Shelter Systems

a. The M51 CPS system is currently the only CPS system with a *litter air lock* available for HSS use. The M51 CPS system is used at the BAS and DCS. A replacement shelter system, the chemical biological protected shelter (CBPS) system, is under development. The CBPS may be attached to the rear of a high mobility multi-purpose wheeled vehicle (HMMWV); it will provide 300 square feet of working space. The CBPS will replace the M51 CPS system one-for-one at the BAS and DCS. Current basis of issue is two M51 CPS systems for the BAS and four M51 CPS systems for the DCS.

b. An Advanced Simplified Collective Protection System that provides an NBC contamination free environment for DEPMEDS-equipped hospitals is also under development. This system will provide a contamination free environment for patient care under CB conditions. It will not protect personnel or patients from the thermal, blast, and initial radiation effects of nuclear weapons; however, it will provide protection against the effects of fallout. The system will include the capabilities for CB protection in TEMPERS, IS0s, and passageways; filtered, conditioned air; ambulatory and litter air locks, and larger air locks for receipt of supplies. However, all areas of the hospital may not be protected. Areas not protected may include minimum care wards, administrative areas, food service, supply (including Class VIII), and staff quarters.

c. The M20E1 simplified collective protection system is another system available. It consists of a chemical room liner, a CB filter blower, and an ambulatory air lock. Currently this system only provides ambient temperature air. The M20E1 is best set up inside a room. It may be used inside tents; however, the available space will be limited by tent poles and other components of the tent. When space is available, the M20E1 can be complexed (two or more interconnected); see the technical manual provided with the system for details.

NOTE

The M20E1 does not have a litter air lock, only staff or ambulatory patients can enter this system.

d. When employing CPS systems, provisions for waste disposal and protected water and food supplies within the CPS are required. Additionally, Class VIII supplies must be protected from contamination. Supplies not in use or needed in treatment areas are stored in medical chest or shipping containers that are inside covered areas, such as closed MILVANs or tents. When contamination is present, only open these storage areas for emergency resupply of operational areas. Use plastic sheeting or other material to provide an additional barrier between the supplies and the contamination. Wrap supplies in plastic or other barrier material for movement from the storage area to the air lock of the CPS.

- If the hospital water supply is not hardened against NBC effects, water may be stored inside the CPS in 5-gallon water cans; 55-gallon collapsible fabric drums; 250-gallon collapsible fabric pillows; 500-gallon collapsible fabric drums; or other available water containers. Store the containers of water in any available area of the CPS such as under tables, beds, and in corners of wards. The storage area must be easily accessible to all hospital personnel in the CPS; also, it must not interfere with patient care.

- Rations, as determined by the hospital commander, should be available for personnel and patients. The rations can be stored in the same area with the water, if required. Ration control measures are established to ensure that the rations are only consumed as provided for in the hospital SOP.

- Human waste devices must also be provided. Portable potties (plastic bag lined or chemical), buckets with plastic bags and bag ties, or other improvisations will do the job. Regardless of the procedure used, the waste must be controlled to prevent odors and health hazards associated with the waste. The area used for these devices should have privacy curtains. Plastic bags can be passed to the outside for disposal through the supply air lock, or on a litter through the litter patient air lock.

- Solid waste (including medical) must be placed in plastic bags. Seal the top of the bags to prevent spillage, odors, or spread of infections/disease. NEVER overfill the bags; always leave enough room in the bag to make a good seal. Pass the sealed bags to the outside through the supply air lock, or on a litter through the litter patient air lock. Outside personnel take the bags to the designated waste disposal site for burial.

D-2. Battalion Aid Station

To establish a BAS using the M51 CPS system, one shelter is set up with medical supplies and equipment in place as designated in the TSOP. Place padding under litter stands and equipment to prevent puncturing the shelter floor. A contaminated triage, patient decontamination station, and a contaminated treatment area is established on the downwind (prevailing wind) side of the M51. An overhead cover of plastic sheeting (at least 20 x 50 feet) is set up over the contaminated triage, decontamination station, contaminated treatment area, and the clean treatment/waiting area; the cover overlaps the air lock. A second area covered with 20 x 25 feet of plastic sheeting (the evacuation holding area) is set up beside the shelter on the opposite side from the generator. The clean treatment area is separated from the decontamination area by a hot line with a shuffle pit. Only clean (decontaminated) patients or personnel are allowed to cross the hotline into the clean treatment area, or are admitted into the M51. Figure D-1 presents one layout of a BAS using the M51 system. Figure D-2 presents one interior layout of the M51 as a BAS. See TM 3-4240-264-12 for set up, operation, and maintenance of the M51 system.

NOTE

1. The overhead cover is not needed when the wind speed exceeds 10 knots per hour. The plastic will not stay in place.

2. Although the BAS has two M51 systems, only one is set up at any given time for use in the contaminated area. This is due to the lack of authorized personnel to operate both systems at one time. The second system can be used without the CB filters when the treatment squad is operating in the split team mode. The second system also provides a replacement in the event that the one in operation is damaged beyond repair. This ensures continued HSS to the command.

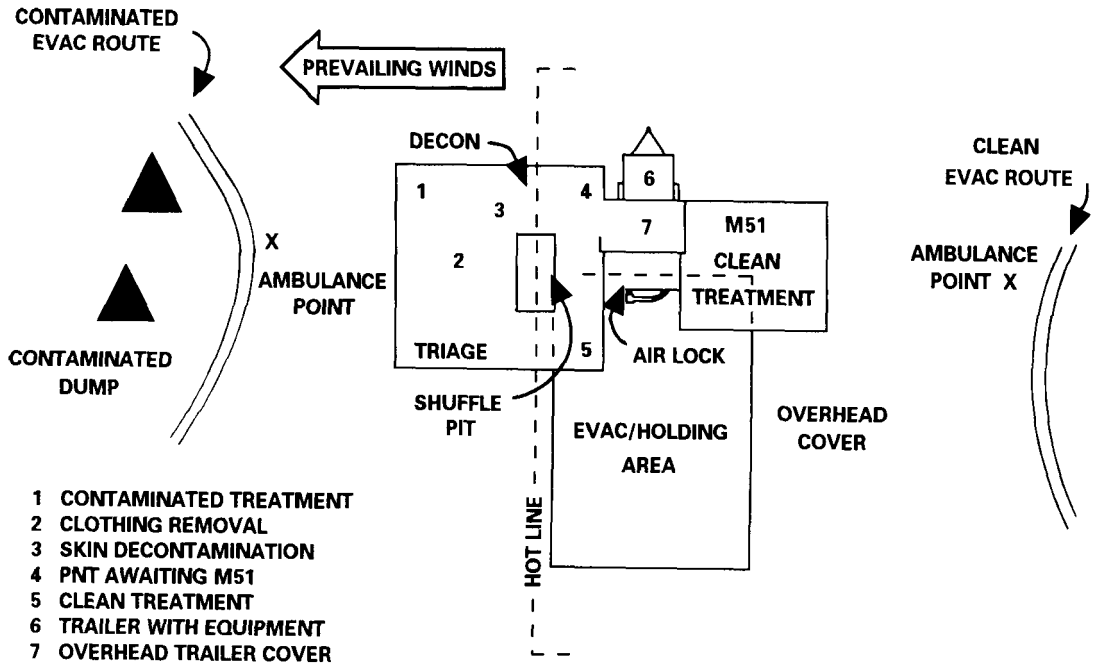

Figure D-1. Battalion aid station using the M51 shelter system.

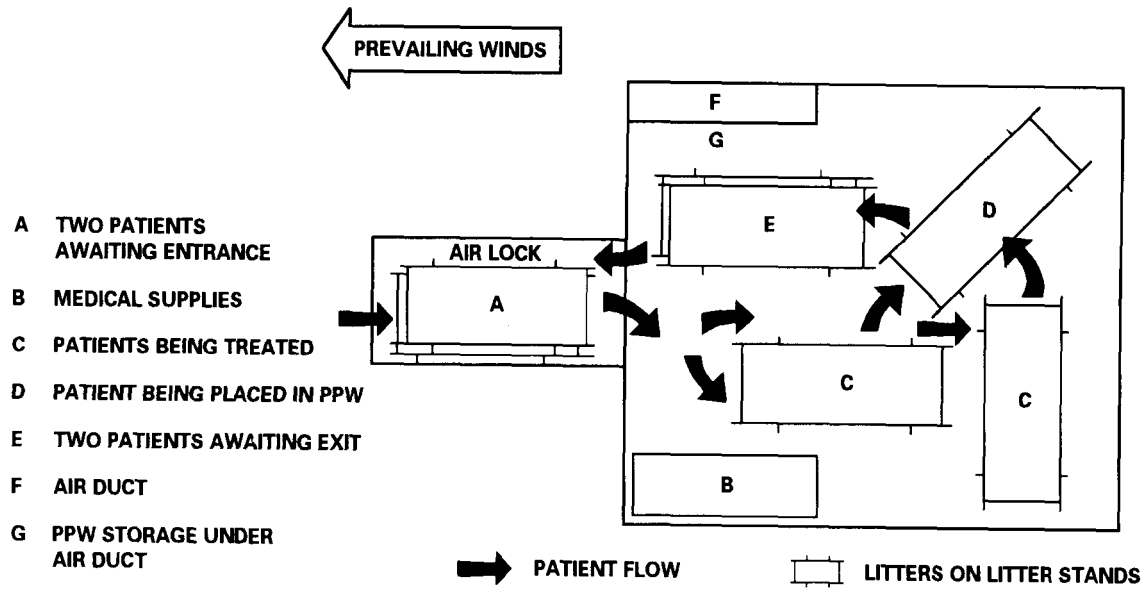

Figure D-2. Battalion aid station interior layout of M51.

D-3. Division Clearing Station

To establish a DCS using the M51 CPS system, set up four shelters with medical supplies and equipment as outlined in unit TSOP. The four shelters are complexed as shown in Figures D-3 and D-4. The pinwheel configuration (Figure D-4) requires a special transition piece. As with the BAS, the triage, decontamination, and contaminated treatment areas are separated from the clean treatment/waiting area by a hot line with a shuffle pit. Overhead covering is provided over the triage, decontamination station, contaminated treatment area, and clean waiting area as described for the BAS. The overhead covering for patients awaiting evacuation to a corps level hospital is established on the upwind end of the M51 systems as shown in Figures D-3 and D-4.

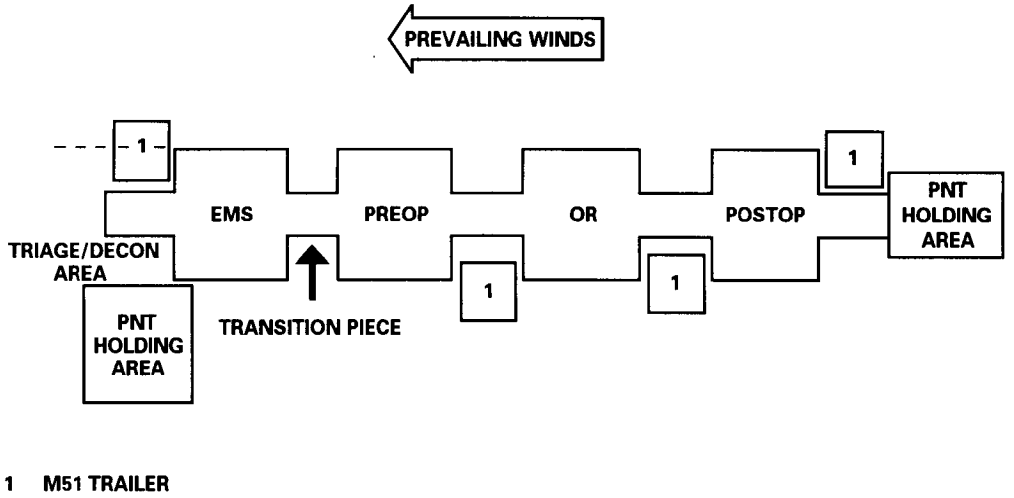

Figure D-3. M51 collective protection shelter straight line configuration as a division clearing station.

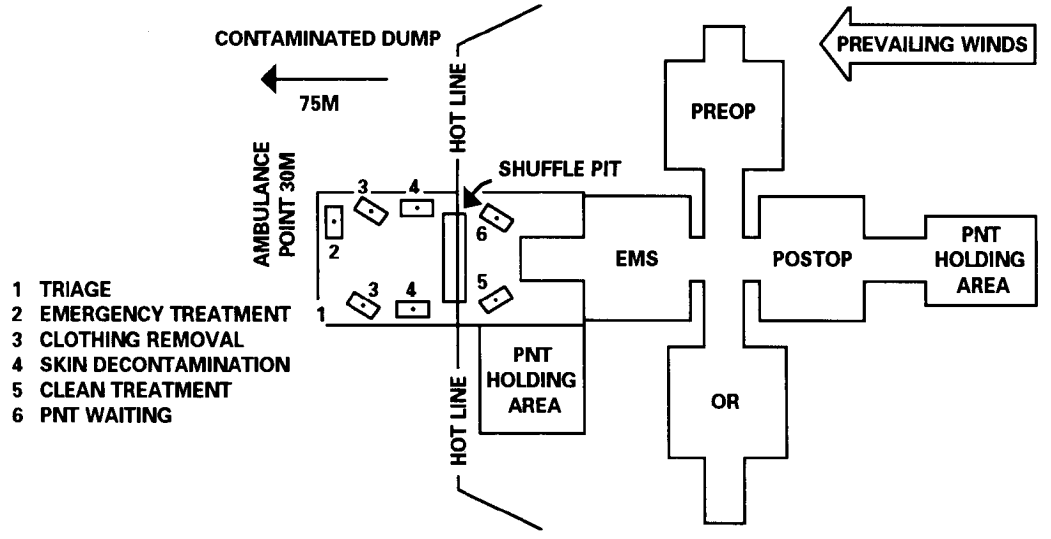

Figure D-4. M51 collective protection shelter pinwheel configuration as a division clearing station.

D-4. Battalion Aid Station in a Chemical Biological Protected Shelter

To establish a BAS using the CBPS system, set up one shelter following the instructions provided in the technical manual or manufacturer's instructions and your unit SOP. All designated medical supplies and equipment are set up as required in the unit TSOP. Provide padding under litter stands and equipment to prevent puncturing the floor. Overhead cover is provided as described for the M51 CPS. The triage, decontamination station, contaminated treatment area, and clean treatment waiting area is established as for the M51 CPS. These areas are separated by a hot line with a shuffle pit. Everyone crossing the hot line must be decontaminated.

D-5. Division Clearing Station in a Chemical Biological Protected Shelter

To establish a DCS with the CBPS, follow the procedures for the BAS except set up four CBPS systems as described in the technical manual or manufacturer's instructions provided with the system. All equipment is set up inside the CBPS as required by your unit TSOP. With four CBPS set up and operational, a total of 1200 square feet of work area is available. A triage, patient decontamination station, contaminated treatment area, and clean treatment/waiting area is established on the downwind side of the CBPS. These areas must have overhead covering as described for the M51 systems.

D-6. Collective Protection in a Deployable Medical System-Equipped Hospital

To establish CPS systems within a DEPMEDS-equipped hospital, follow the procedures as described in the manufacturer's instructions or the technical manual on the CPS system to be used. Training Circular 8-13 provides instructions on establishing a DEPMEDS-equipped hospital (without CPS).

D-7. Hardening the International Organization for Standardization Shelter

To complete the hardening effort of the DEPMEDS-equipped hospital, the IS0 shelter must be hardened. The seams and openings of the IS0 must be sealed to prevent the entry of CB agents. The environment control unit (ECU) must be hardened and the vestibules between the IS0s or the IS0 and TEMPER tent must be hardened.

D-8. Establish Collective Protection Shelter With the M20E1 Simplified Collective Protection System

The M20E1 is used to establish a CPS within a room of opportunity, or in tentage. Two or more M20E1s may be complexed if the supporting shelter provides sufficient room. See the technical manual provided with the system for set up procedures.

D-9. Patient Decontamination

Patients admitted into the MTF must be contamination free. Therefore, a patient decontamination area must be established near the MTF. The patient decontamination area should be provided with an overhead cover as described for the M51 shelter system, except that it does not overlap the entry

to the hospital. Also, consideration must be given to the location of other operations at the hospital site when establishing the patient decontamination area. However, the area must be close enough to the entry/exit of the CPS to protect the patients from the environment and reduce their exposure to recontamination. Keep in mind that under NBC conditions personnel outside of the CPS are at MOPP Level 4 (except decontaminated patients; they have their mask on), thus increasing the stress load and reducing their overall performance capabilities. The entry/exit area must have overhead cover to protect patients awaiting access to the CPS. Figure D-5 shows one configuration of a patient decontamination area at a hospital; add more clothing removal lines setup as the mission requires. Figure D-6 shows overhead cover at the entry/exit area.

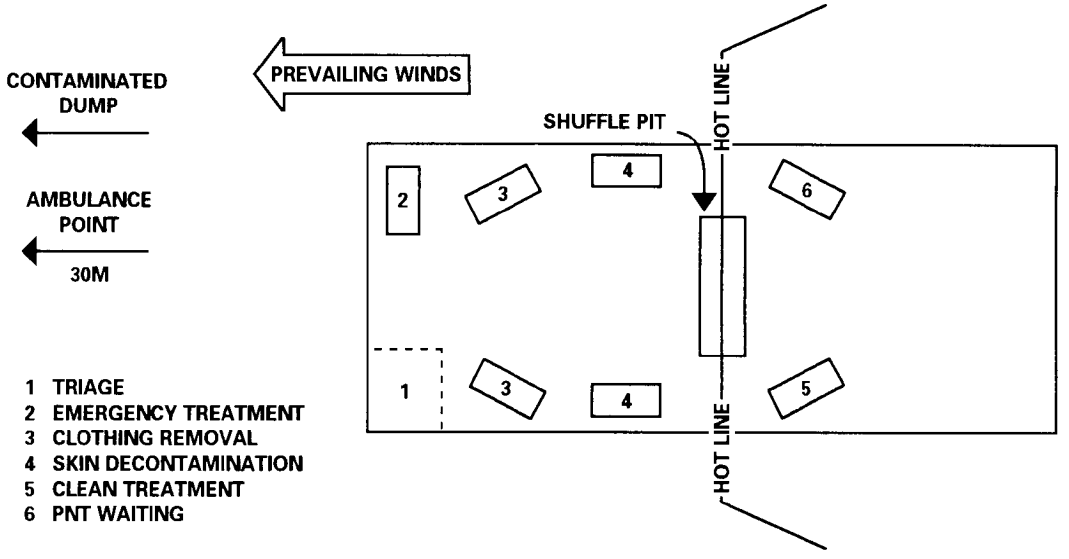

Figure D-5. Patient decontamination area.

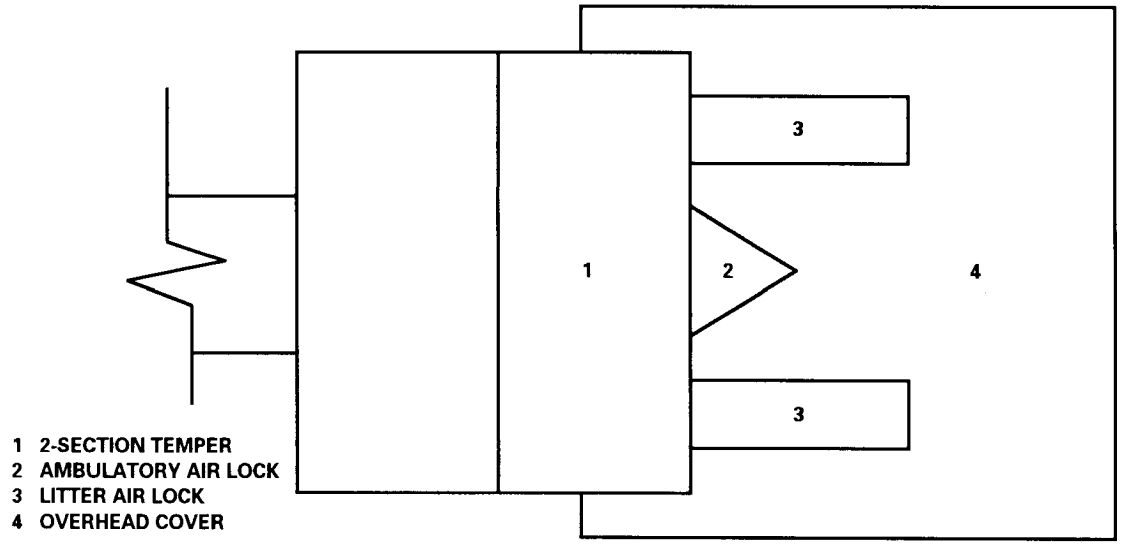

Figure D-6. Overhead cover at the entry/exit area.

D-10. Entry and Exit Guidelines

Guidelines for operation, entry, and exit of CPS may be used to prepare an SOP for the operation of CPS systems in your unit.

a. When using these guidelines, the following should be considered:

- Location of the shelter.
- General climate of the AO (high and low temperature variations during operation).

b. Information on setting up, striking, and operating the CPS is contained in equipment publications. Where applicable, special procedures are provided in these publications for setting up in both contaminated and uncontaminated areas. The commander will determine which procedures to use.

c. During operations, periodic checks are made of the atmosphere within the shelter. These checks are made by using available chemical agent detection equipment/material (such as the CAM), the chemical agent detector kit, or an alarm to determine if there is agent penetration. Should chemical agent penetration occur, all personnel must mask until the agent has been purged from the shelter.

D-11. Decontamination of Area Around Entrance

a. Normally, the MTF will not operate in a contaminated environment. However, if the MTF must remain in an area on a temporary basis and liquid agent contamination is present, the immediate area around the entrance must be decontaminated.

b. To decontaminate the area around the entrance use one or more of the following methods:

- Turn over about 4 inches (10 cm) of soil.
- Remove the top layer of soil containing any liquid agent. Use the CAM or M8 detector paper (paper, chemical agent detector, VHG; ABC-M8 from the detector kit) to check the area after top soil removal to ensure complete removal of the agent.
- Add several inches of clean soil or sand.
- Mix STB into the soil to make a shuffle pit.
- Use DS2 decontaminant on contaminated ground that is hard-surfaced or frozen.

D-12. Procedures Prior to Entry

All personnel (staff and patients) must be decontaminated before they are permitted entry into the CPS.

- Use chemical detection equipment (such as the CAM or M8 paper) to check for the presence of contamination on individuals, their equipment, or weapons. Thorough decontamination is critical in preventing contamination transfer into the CPS.

- If a chemical agent is detected, follow the procedures in Appendix C for patient decontamination and FM 3-5 for other personnel decontamination entering the CPS. All contaminated clothing and equipment is placed in the contaminated dump. Weapons should not have been evacuated with patients. However, if weapons are evacuated with the patient, they are decontaminated and held for disposition instructions.

- Decontamination must be thorough; procedures must be strictly followed. Failure to do so can contaminate the medical system and injure medical treatment personnel, reducing their mission support capabilities.

WARNING

WHEN OPERATING IN A TOXIC ENVIRONMENT, NEVER OPEN THE OUTER AND INNER DOORS OF THE AIR LOCKS AT THE SAME TIME.

D-13. Entry/Exit for the Collective Protection Shelter System

a. *Ambulatory Personnel.*

(1) *Entry procedures.*

(a) Ambulatory patients and others remove their overgarments and overboots (booties) outside the air lock. This procedure reduces the amount of contamination entering the air lock.

(b) A check is made to ensure that the ambulatory airlock is empty and the inner door is closed.

(c) The individual enters the air lock and closes the outer door.

(d) At the end of the purge cycle (5 minutes), the boots and mask are removed and placed in a plastic bag; the bag is sealed and marked. The individual checks his BDU for contamination. If contaminated, the BDU is also removed and placed in a plastic bag. The gloves are removed and placed in the plastic bag with the BDU, or in a separate plastic bag. All plastic bags containing removed items are sealed and labeled. The individual opens the inner air lock door and enters the CPS; the plastic bags are carried into the shelter with the individual.

(2) *Exit procedures.*

(a) A check is made to ensure that the ambulatory airlock is empty and the outer door is closed.

(b) The individual enters the air lock and closes the inner door.

(c) The individual puts on his BDU, boots protective mask, and gloves; then exits through the outer door.

(d) The individual assumes the established MOPP level before departing the immediate area of the exit door.

WARNING

DO NOT OPEN THE OUTER DOOR UNTIL THE PROTECTIVE MASK HAS BEEN PUT ON.

NOTE

Exits must be spaced at least 3 minutes apart to permit purging the air lock of contaminants that entered while the outer door is open. Only open the doors long enough to permit passage.

b. Litter Patients.

(1) *Entry procedures.*

(a) An outside aidman notifies an inside aidman that a litter patient is ready for admission.

(b) The inside aidmen ensure that the inner litter air lock door is closed. The outside aidmen open the outer airlock door and place the litter on the litter rails; they push the patient into the air lock head first; then they close the outer door. After a purge time of 3 minutes, an aidman inside the CPS opens the inner door; the patient is checked to ensure that he is contamination free. The patient is checked by placing the CAM nozzle near absorptive surfaces, such as the patient's hair. If no contamination is found, the aidman removes the patient's mask and places it in a plastic bag. The inside aidmen remove the patient from the air lock and position him on treatment litter stands, or move him to the treatment area as directed by supervisory personnel.

(c) Patients received at the treatment facility in the PPW are checked for contamination; if they are contamination free, they may be processed through the litter air lock in the PPW. The inside aidmen ensure that the inner litter air lock door is closed. The outside aidmen open the outer air lock door and place the litter on the litter rails and push the patient into the litter air lock head first, then close the outer door. Purge the air lock for 3 minutes. After the purge time, an aidman inside of the CPS opens the inner door and uses the CAM to check the patient to ensure that he is free of contamination. If no contamination is found, the inside aidmen remove the patient from the air lock. (If the patient is wearing a protective mask, the mask is removed and placed in a plastic bag before the patient is moved from the air lock.) As the patient is removed from the air lock, the PPW is opened and rolled inside out so that any desorbing vapors are adsorbed by the charcoal

layer. The inside aidmen remove the patient from the air lock and position him on litter stands. The patient is transferred to a clean litter; then moved to the treatment area as directed by supervisory personnel. The receiving litter and PPW is returned to the outside; dispose of the PPW in the contaminated waste dump. Decontaminate the litter and return it to the litter pool.

NOTE

Should contamination be found when monitoring the air lock in *(b)* or *(c)* above, repeat the purge cycle then retest for contamination. All vapor hazard must be eliminated before the patient is moved into the CPS. Repeating the purge cycle may NOT be possible if the patient is in need of immediate lifesaving care. The patient may have to be returned to the outside treatment area for immediate care.

(2) *Exit procedures.*

(a) The litter patient is placed in a PPW.

(b) An inside aidman notifies an outside aidman that the patient is ready to exit the shelter. An outside aidman ensures that the outer air lock door is closed. The patient is placed in the litter air lock feet first. The inner air lock door is closed. The outside aidmen open the outer door and remove the patient.

(c) Hospital staff, visitors, or ambulatory patients exit through the ambulatory air lock. Before entering the air lock, each individual must ensure that the outer air lock door is closed. The individual enters the air lock and closes the inner door; puts on his protective ensemble and exits through the outer door.

WARNING

DO NOT OPEN THE OUTER DOOR UNTIL THE INNER DOOR HAS BEEN CLOSED.

NOTE

Exits must be spaced at least 3 minutes apart to allow for a complete purge of the air lock.

D-14. Resupply of Protected Areas

Resupply of protected areas is accomplished by placing contamination-free supplies or equipment on a litter and passing it through the litter air lock, or processing it through an air lock designed for resupply.

APPENDIX E

DETECTION AND TREATMENT OF CONTAMINATED WATER

E-1. General

Water supplies in areas with NBC contamination and in surface water supplied by runoff from such areas will most likely be contaminated. The contamination of water, whether intentional or inadvertent, may reach concentrations that will produce casualties. By special methods of analysis, the presence of contamination can be determined. Treatment of contaminated water requires chemicals and equipment that are only available to quartermaster water purification units; individuals or units should not attempt to treat their water. Decontamination of water is only undertaken when uncontaminated sources are not available; then ONLY with the approval of the medical authority (PVNTMED or surgeon).

E-2. Detection of Contamination in Water

a. Detection of nuclear contamination in water is accomplished by using the AN PDR/27 or AN VDR/2 radiacmeters.

b. Detection of biological agents in water is accomplished by the use of field biological water test kits and specially designed collection and detection kits. The specialty kits will be provided as needed, and will be available to PVNTMED and supporting laboratory personnel.

c. The Chemical Agent Water Testing Kit, M272, provides a rapid field test to detect chemical agent contamination in water. The test must be conducted before the water is treated with chlorine; the chlorine will affect the accuracy of the test for chemical agents. An updated version of this kit may also detect toxins.

E-3. Procedures on Discovery of Contamination in Water

When contamination is discovered the following actions are taken:

a. Mark the water source, using the standard contamination markers, and ensure that personnel do not consume the water until approved.

b. Notify the commander that the water source is contaminated and unfit for drinking, food preparation, and personal hygiene.

c. The commander establishes safeguards to prevent personnel from using the contaminated water supply.

d. An alternative source of uncontaminated water is sought and used. The primary source for obtaining water is from quartermaster-operated water production and distribution points. Other sources are considered only when quartermaster-operated facilities are not available. Alternative sources that may be considered include—

- Ground water source which is least likely to be contaminated.
- Local fixed facility water supplies.
- Movement to another location to obtain an uncontaminated water source, when the tactical situation permits.

e. Contaminated water must not be used until it has been treated by quartermaster water purification units and approved for use by the medical authority.

E-4. Treatment of Contaminated Water

Contaminated water requires additional equipment and supplies to remove the contamination. Quartermaster water purification and distribution units are equipped to perform these duties. See FM 10-52 for details.

APPENDIX F

FOOD CONTAMINATION AND DECONTAMINATION

F-1. General

a. Food Susceptibility. Stored, transported, and prepared food is susceptible to NBC contamination throughout the TO. Planning for any battle or operation must include food protection from contamination; food contamination detection; and contaminated food disposition (decontaminate or destroy).

b. Countermeasures. There are three primary countermeasures to overcome or reduce the NBC hazard to food:

(1) Contamination avoidance.

(2) NBC agent detection.

(3) NBC agent decontamination.

c. Priorities. The priorities for conducting NBC countermeasures are—

(1) Contamination avoidance. Contamination avoidance includes using natural and fabricated barriers to prevent, or significantly reduce the spread of contamination. Also, using specific procedures for entry and exit between contaminated and uncontaminated areas reduce the potential for spreading contamination. Use of these barriers and procedures may reduce the subsequent need for detection and decontamination.

(2) Detection, measurement, and identification. These activities are essential for determining the presence, extent, and nature of NBC contamination. This information is essential in identifying the existence of uncontaminated supplies, or decontamination requirements.

(3) Decontamination. Decontamination removes the contaminant and provides food that is safe for consumption.

d. Decontamination. Decontamination efforts require an extensive amount of labor, time, and supplies. The use of hasty decontamination is emphasized. That is, decontaminate just enough to sustain operations and keep fighting, rather than to make a contamination-free environment. Normally, decontamination efforts will be limited to the packaging and packing materials. Food decontamination will only occur in critical situations where other food supplies are not available. Most decontamination is performed in or very near the AO. Before beginning decontamination procedures, divide exposed food items into groups based on protection of item at time of exposure. These groups establish priorities based on ease of decontamination and the ability to monitor the food.

(1) Group I—Canned or packaged items exposed only to a chemical agent vapor.

(2) Group II—Canned or packaged items that are contaminated on the outside with a liquid chemical agent, a biological agent, or radioactive fallout.

(3) Group III—Unpacked or poorly packaged items that have been exposed to any NBC of agent.

(4) Group IV—Food contaminated through the food chain.

F-2. Protection of Food from Contamination

An adequate defensive posture for a chemical attack will also protect food against biological contamination and radiation fallout.

a. Operational Rations. Operational rations include, but are not limited to: T rations, meals ready-to-eat (MREs), survival rations, B rations, and medical B rations.

(1) Packaging materials and storage methods normally protect these rations. The packaging and packing of operational rations protect the contents from deterioration. As a result, the contents are protected from moisture, to include chemical liquids, chemical vapors, and biological agents. Operational rations delivered to an AO will usually have increased levels of packaging and/or packing protection. Operational rations are substantially protected while contained in the shipping cases, especially if protected with an overlay of fiberboard, shrink wrap, or film wrap.

(2) Enclosed storage is used whenever possible. Refrigerated warehouses, cold storage rooms, and even prefabricated refrigerators and trailers provide excellent protection. Underground shelters, caves, and tunnels that can be made airtight provide maximum NBC protection. Buildings provide protection depending on how well they can be closed and sealed. The basement of a building is a good storage place. However, keep in mind that chemical vapors tend to seek out low-lying areas. Storing rations indoors will protect them from liquid droplet and fallout contamination unless the building is damaged by an attack. Complete protection against chemical vapors is only offered by airtight closed spaces like cold storage facilities.

(3) Chemical protective measures are to be integrated into daily logistical operation to avoid the contamination of operational rations. Maximum use is made of alarm and detection equipment, overhead shelter, shielding materials, and protective covers. Back up stocks of operational rations should be dispersed to minimize the risk of destruction or contamination.

(4) An NBC Protective Cover or similar equipment will help greatly. The NBC Protective Cover is discarded and replaced upon becoming contaminated; it reduces overall decontamination requirements; and it improves the survivability of supplies and equipment. The NBC Protective Cover provides 24-hour protection against liquid chemical contamination. Detection paper used on the NBC Protective Cover will rapidly identify a contaminated cover.

b. Bulk and Fresh Foods.

(1) Field expedient or improvised storage may be the only choice available under high risk conditions. Expedient storage for food supplies may be a natural or man-made depression lined to protect contents against moisture, and then covered with earth and sod. The earth gives good protection against all forms of chemical or biological contamination and nuclear fallout.

(2) Foods are only stored outdoors or in partially protected areas when absolutely necessary. Only cases of foods packed in cans, bottles, or airtight foil or film wraps, and foods packed in sealed boxes or multilayered wrappings can be subjected to exposed storage. Partial protection is provided by open sheds, temporary roofing, or tents. When subsistence must be stored in the open, give as much protection as possible. Protection material may include NBC Protective Covers, tarpaulins, tarpaulin sheds, or any other available covering such as plastic sheeting. Tarpaulins and other treated or waterproof coverings do not prevent contamination by chemical vapors, but they do reduce contamination from liquid agents. Canvas will keep out more than 95 percent of liquid

contamination for a short period of time after the attack. The canvas must be removed soon after the attack to prevent the agent from seeping through onto the subsistence; placement of spacers between the covering and the food will greatly reduce this problem. Even the thinnest material will offer some protection and is better than nothing at all. Therefore, food supplies must be covered by whatever material is available.

F-3. Nuclear

a. Contamination.

(1) Following a nuclear detonation food can become contaminated in three ways:

- Direct contamination. Direct contamination results by fallout collecting on plants, animals, and stored food (surface contamination). Fallout has two effects. First, it produces a gamma radiation field over the fallout area. Second, it contaminates the surface of anything on which it is deposited. The whole-body gamma irradiation hazard to an individual far outweighs any potential hazard from food contamination. The basic rule is: If you can safely be in the area to salvage the food, then the food salvaged is safe to use (although slightly contaminated).

- Indirect contamination. This form of contamination can be spread throughout the food chain. Humans can ingest contamination by eating plants which have absorbed radioactive isotopes; products (milk or meat) from animals allowed to graze on contaminated pastures; or fish from contaminated water.

- Induced radiation. It is possible that food will be exposed to sufficient neutron flux (an increase in the number of free neutrons) as the result of a nuclear explosion to produce considerable induced radioactivity in food without it being destroyed by blast and heat. This is possible with enhanced radiation weapons in the energy range of 1 KT where the radiation kill radius exceeds the blast destruction zone. The elements that are most prominently involved are sodium, potassium, sulfur, copper, bromine, zinc, and especially phosphorous. Thus, in an area of induced radiation, foods requiring the most caution are dairy products, high salt content foods, dry beans, raisins, and ready-mixed cake and biscuit flours. The radioactivity has a short half-life; therefore, the radiation will decay very rapidly. It should be possible to consume foods containing induced radiation within a week or two. Cans, particularly those with “C” enamel, may incur a high level of induced radiation (from zinc in the enamel, not from iron in the can). Glass, because of its high salt content, will show very high levels of activity; clear glass will turn brown. Container radioactivity has no bearing on the food, it is safe to use. The radioactivity is not transferred to the contents. No significant toxic by-products are formed in the exposed canned food.

(2) Consumption of food contaminated with radioactive fallout may cause a risk of radiation injuries from internal radiation; that is, radiation from radioactive sources within the body. Most isotopes will pass through the digestive tract or be excreted very quickly. However, the intestinal tract may receive a considerable dose. Some isotopes are more hazardous because they are absorbed from the digestive tract and enter the metabolism of man and animals.

- Strontium-89 (Sr-89) and Strontium-90 (Sr-90) are beta emitters and have half-lives of 51 days and 28 years respectively. Therefore, Sr-90 is the greatest radiation hazard in the long term. These two isotopes are absorbed in the body and used in the same way as calcium. They accumulate in bone, where bone marrow with its blood forming cells is vulnerable. Milk and other dairy products are the primary sources of Sr-89 and Sr-90 in the human diet.

- Iodine-131 (I-131) is a beta and gamma emitter and has a short physical half-life of approximately 8 days. It is efficiently absorbed and used by the body. Iodine-131 will contaminate plants which will be eaten by grazing animals. Smaller amounts can also be absorbed by breathing contaminated air. Cattle will excrete a large amount of I-131 in milk. Milk and other dairy products are the primary sources of I-131 intake. One can also get smaller amounts by eating contaminated fruits and vegetables. Iodine-131 will be concentrated in the thyroid gland. The intake of I-131 will have its greatest impact the first few days to weeks following a nuclear explosion.

- Cesium-137 (Cs-137) is a beta emitter and has a half-live of 30 years, but is eliminated relatively quickly from the body. The biological half-live is 70 to 140 days. Cesium- 137 is found in most tissues of the body, but it will concentrate in muscle tissue. Cesium-137 is absorbed and used the same way as potassium. Meat and milk are the primary sources of Cs-137. Much precipitation, lack of minerals in the soil, and extensive cultivation increase the plants' absorption of Cs-137; thus, the contamination of plant products.

(3) Operational rations are safe when surface decontamination is performed before breaking the package. Operational rations stored close to ground zero may become radioactive from induced radiation. It is more likely, however, that the food will be damaged or destroyed by the blast and thermal effects of the nuclear explosion.

(4) Bulk and fresh food stored in the open without protection will be contaminated. Decontamination is very difficult and time-consuming. Efforts should be made to ensure proper packing to prevent food contamination from radioactive fallout. Packing made from hard and nonporous materials, such as plastic or multilayer cardboard with a smooth surface, should be used. In addition, storage facilities should be enclosed to avoid the entry of fallout. Any material used as a protective cover will give some protection against nuclear fallout. Protection against induced radiation, blast, and thermal effects requires a hardened shelter or underground storage.

(5) Food supplies require protection throughout the chain of production or procurement. Protection of the civilian based food supply includes countermeasures along the production chain. Meats and milk are the most vulnerable products because of the possibility for concentration of radioactive isotopes (Strontium, Cesium and Iodine). The primary, and possibly the only, protection of animal products is to keep the animals in-doors and to avoid contaminated fodder. Immediate slaughter of food animals is recommended if there is a shortage of uncontaminated fodder. Also, food animals exposed to fallout should be considered fit for consumption and slaughtered using routine procedures. Unharvested crops cannot be protected.

b. Inspection and Monitoring.

(1) Fallout close to ground zero, especially after a surface burst, may be visible as dust. The presence of dust is an immediate indicator of contamination. Fallout on unprotected food produces a grittiness which is unpleasant and warns against eating the food. The degree and means of food protection (packaging and storage facilities) must be considered. Food in a building that remains intact should not receive enough contamination to be dangerous when eaten.

(2) Veterinary units have the IM-174A/PD to conduct ground or aerial surveys for gamma radioactive contamination levels in an area. The measurement of the external gamma radiation in the fallout area is an indication, but not a quantitative measure, for the degree of hazard from food contamination. These units also have the AN/PDR27 Radiac Set to detect point sources of gamma and beta radiation and to measure gamma radiation. Food monitoring is conducted in an area

with low background radiation. If the storage area is contaminated, the food must be moved to a cleaner area for monitoring. With the AN/PDR27, the initial food monitoring is performed with the probe window closed and the probe passed approximately 6 inches from the surface. If the reading is twice the background dose rate, the food is considered contaminated. If the reading is not above the background level but contamination is still suspected, place the probe closer to the food with the beta shield open. Monitor meat and fish with the probe open; pass the probe approximately one-half inch from the surface of the food.

(3) Monitoring food contaminated through the food-chain is more complicated; depending on the detection instrument used, special procedures must be followed. Gamma and beta emitting radionuclides in small volumes may be detected using radiac sets such as the AN/PDR27; however, alpha emitting ones cannot. They are rough instruments and may be used only for screening surface contaminated food. To evaluate the hazards; the isotopes contributing to the radioactivity must be identified. Surface contaminated food will contain a mixture of isotopes with some more hazardous than others, depending upon whether they are used by the body. Milk will contain mostly I-131, Cs-137, Sr-89, and Sr-90. Meat and fish will contain mostly Cs-137. To verify I-131, CS-137, Sr-89, and Sr-90 contamination, samples must be sent to laboratories equipped to analyze the samples.

(4) All newly selected food supplies must be surveyed. Begin continuous monitoring immediately following receipt of a fallout warning, or when increased levels of radiation are detected by periodic monitoring.

(5) Periodic monitoring is needed to establish baseline levels of background radiation in the environment and various food products. This monitoring is performed during peacetime, when possible, and throughout the time US forces are deployed in a TO.

NOTE

The IM174A/PD and AN/PDR27 are being replaced by the AN/VDR2 Radiac Set. The AN/VDR-2 detects lower levels of gamma and beta radiation than the AN/PDR27 and higher levels of gamma radiation than the IM-174A/PD.

c. *Decontamination.* There are two methods for nuclear decontamination: aging and removing. Aging is the process of allowing natural radiation decay to occur. The time necessary for this decay to take place depends upon the isotopes present; each has a different decay rate (half-life). Aging may not be possible when there is a short food supply. In some instances, such as with induced radioactivity, it maybe the only way to decontaminate. Removing nuclear contamination from areas, personnel, food, or moving equipment to another location eliminates the immediate hazard. To determine which decontamination method is required, food supplies are divided into groups. See Table F-1 for additional information on food items and decontamination.

(1) Group II—Food in sealed and dust-proof packing such as cans, jars, fiberboard, and cellophane. These products are easily decontaminated by removing the radioactive dust covering the packing. This is done by brushing, washing with soap and water, or removing the packing (depending on the type of packing material). If radiation is still detected after removing the dust, repeat the brush/wash procedure and remonitor. If radiation is still present, the food itself is then considered

radioactive (induced radiation) and is unfit for consumption. Decontamination of induced radiation is possible only through aging. After aging one to two weeks, the food should be safe for consumption. After surface decontamination, the contents are safe to eat unless the food has induced radiation.

(2) Group III—Unprotected food. The method chosen to decontaminate unprotected food items will depend upon whether or not the food supply is critical. If the food supply is not critical, the contaminated items are isolated and allowed to decontaminate by aging. If the food supply is critical, food with surface contamination can, in principle, be decontaminated by removing the contaminated surface, or by washing.

(3) Some products can be decontaminated by washing, peeling, or trimming the outer skin or leaves. Decontaminate potatoes and hard-skinned fruits and vegetables by washing or scrubbing under running water, followed by peeling or scraping, then washing again. Potatoes, carrots, beets, and turnips can be washed at the supply depot. However, do not wash beans, rice, and onions until they are delivered to the field kitchen; washing reduces their storage quality and shelf life. Citrus fruits, pineapples, corn, peas, beans, melons, pumpkins, cabbage, and nuts can be peeled. Decontaminate cucumbers, tomatoes, cherries, cranberries, grapes, pears, plums, and thin-skinned squash by soaking in a water or detergent solution and rinsing with vigorous agitation or brushing. Apricots, peaches, most berries, asparagus, broccoli, and leafy vegetables cannot be satisfactorily decontaminated because of fuzzy surfaces, irregular shapes, or small size which makes washing difficult.

- Fresh carcass meat, sausages, and fish can be decontaminated by several washings with cold water. The exterior layer of the food item is removed if radioactivity is still present. There is, however, a risk of contaminating the inner parts of the foodstuff in the process. Cooking with several changes of water is the last step in decontamination.

- Decontaminate hard cheeses, margarine, and butter by cutting off the outer layer to a depth of 2.5 to 3 cm.

- Let cooking oils stand for 3 to 5 days, then pour off the contaminated layer; use a funnel to control spillage.

- Nonperishable items that are hard to decontaminated, such as flour, sugar, and salt can be set aside allowing natural radioactive decay. When supplies are short, dilute the contamination by mixing with uncontaminated food, This will reduce the total amount of radioactive exposure in foods prepared using these contaminated items.

- Decontaminate air permeable, double sacked goods by removing the outer sack. If the inner sack is free of radiation, double sack the food again to restore protection. However, when contamination is present on the inside bag, the food in contact with the bag is likely to be contaminated. Three methods can be used to handle this type of contaminated product. The easiest method involves spraying the bag of dry goods (except sugar or salt) with water. This will wet a layer of the food inside the bag. The wet layer can be removed when the bag contents are emptied. The uncontaminated contents are scooped back into clean packaging. Another method involves using melted paraffin to uniformly coat the outside of the bag. The paraffin solidifies after 30 to 40 minutes,

then the bag with the radioactive contamination can be removed from the contents. Although this method will seal the radioactive substance in the wax, it probably will not remove the layer of contaminated food product inside the bag. For the third method, form a piece of sheet metal into a cylinder the same height as the bag and 4 to 6 cm smaller in diameter. Insert the cylinder into the bag, then remove the top 3 to 4 cm of the contaminated product. Carefully scoop the remaining product out into a clean sack. With the cylinder still in place, fold the bag down catching the contaminated product on plastic sheeting, or a tarpaulin. When using this method, mixing the contaminated portion with the uncontaminated portion is a problem. Check for contamination remaining in the product.

- Boiling or cooking has no effect on radioactive contamination.

(4) Group IV-Food contaminated through the food-chain. It is not practical to decontaminate this food. Meat and milk are the two most common foodstuffs contaminated in this way.

- Milk may be decontaminated to a safe level by a complicated ion exchange process. The I-131 activity will decline rapidly during storage of milk and milk-products, although the Cesium and Strontium activity will remain almost constant for years. In an area with high-level fallout, milk is withdrawn from human consumption. The duration of withdrawal will be dependent upon the type of fallout and levels.

- Meat may be decontaminated to a safe level by soaking in water or brine. Cesium is loosely bound in the meat. By repeated soaking of meat cut in small pieces, most of the Cesium activity will be removed. Traditional meat preserving, such as salting with brine, will remove up to 60 to 70 percent of the Cesium activity. See Table F-2.

- Fruits, vegetables, root-crops, and grain products may also contain hazardous amounts of radioactivity if ingested.

(5) Food animals. Food animals that have been exposed to fallout should be considered fit for consumption and slaughtered using routine inspection and slaughter procedures. In those cases where the animal has been exposed to fallout, but is not scheduled for immediate slaughter, the radiation burden can be reduced by moving the animal to an uncontaminated area (barn if available) and washing it with soap and water. Mild radiation sickness does not necessarily mean that the animals cannot be used for food. If the animals have been exposed to an internal radiation hazard, the meat can be eaten if the internal organs are discarded. Chickens that have eaten radioactive material may lay contaminated eggs, but most of the radioactivity will be concentrated in the shells. The white and yolk will be free of harmful amounts of radiation and can be eaten. Chickens will not lay eggs if the radioactive body burden is large enough that their eggs are unfit to eat.

d. Considerations When Decontamination is Not Possible. When food cannot be decontaminated, sealing the product in a wrapping material or container may be needed. Sealing the product can reduce or shield the emanation of the contamination and/or fix the contamination in place. The hazard from contaminated food is small compared with that from external gamma radiation. Hungry people or animals should not be denied food because of possible fallout contamination. It is not practicable or desirable to pre-set maximum permissible limits of gross fallout radioactivity as a basis for judging whether or not food should be used. Common sense must be applied in establishing priorities for distribution of available food. For example, use the least contaminated and the most protected food first; hold milk products for 1 to 2 weeks before use.

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Table F-1. Decontamination of Food Supplies

SURFACE OR MATERIAL	TYPE OF CONTAMINATION		
	CHEMICAL	BIOLOGICAL	NUCLEAR
Canned, bottled, or protected by impermeable container.	• Immerse in boiling, soapy water for 30 minutes and rinse. • Immerse in boiling water for 30 minutes. • Spray with DS2 and rinse. • Wash in hot, soapy water, rinse, and aerate.	• Wash with soap and water, then immerse in disinfectant solution. (Disinfectant, chlorine, food service, or 1/3 canteen cup of household bleach in 10 gal of water). • Boil in water 15 minutes; not effective on toxins and some spores. • Immerse in 5% sodium carbonate (4 lb washing soda in 10 gal water), rinse with potable water. • Immerse in household bleach solution (1/2 gal bleach in 25 gal water) for 30 minutes then rinse and aerate for 10 minutes. • Immerse in HTH solution (1/2 lb in 25 gal water) 20 minutes, then rinse. • Immerse in STB solution (1 lb in 25 gal water) 30 minutes, then rinse. • Immerse in 2% peracetic acid for 10 minutes, rinse, and aerate for 10 minutes.	• Wash with soap and water, rinse. • Brush, wipe contamination from surface of container.
Not canned or impermeable container	• Food known or suspected to be contaminated should not be consumed until approved by veterinary personnel.	• Boil in water 15 minutes. Cook. • Immerse in or spray with 2% household bleach solution. (Packaged, peeled, or pared food may be immersed or sprayed.)	• Wash or trim contamination from unpackaged food.

Table F-2. Traditional Salt Preserving Brine

MEAT, WHOLE 4-5 KG
25% NaCl (salt) brine. 5 liter brine per kg. Keep meat in brine for 3 weeks, temperature below 10°C. Soak in water for 1-2 days. 65-70% of Cs activity will be removed.
MEAT, CUT 1-2 KG
25% NaCl brine. 5 liter brine per kg. Keep meat in brine for 4 days. Soak in water for 4 hours. 65-70% of Cs activity will be removed.
MUTTON/LAMB RIB
Piece of rib 1-5 kg. 25% NaCl brine. 5 liter brine per kg. Keep in brine for 2 days. Soak in water for 2 hours. Air-drying for 10 days. Soak in water for 2 hours. Boil in water for 3 hours. 85-90% Cs activity will be removed.
DECONTAMINATION OF COARSELY CHOPPED MEAT
0.9% NaCl solution. 2 liter solution per kg. Soak in NaCl solution for 10 min. 60-70% Cs activity will be removed. Repeated procedures will remove the same percentage of Cs activity. Six times repeated treatment will remove nearly 100% of Cs activity.

F-4. Biological

a. Contamination. Biological warfare agents exist in the form of toxins and microorganisms. The normal packaging and packing of food (to protect against moisture, dust, and bacterial or other contamination) provides protection against most biological agents. The exception may be toxins and biologically derived substances. However, the protective methods used for chemical agents will also protect against toxins and derived substances. Food in freezers, refrigerators, and in refrigerated trucks or rail cars will be safe if these containers remain sealed until the outer surfaces are decontaminated.

(1) It is unlikely that a biological agent will affect the appearance, taste, or smell of the food enough for the change to be apparent.

(2) Packaging and packing materials are not life supportive to pathogenic agents and are therefore self-decontaminating with the exception of spore-forming organisms.

(3) Most operational rations are packaged in metal containers, or encased in heavy aluminum laminated plastics that can withstand boiling water; also, they are impervious to arthropod penetration. This food is highly resistant to biological agents.

(4) The use of unpackaged items (unwrapped meats, fresh fruits, and vegetables) should be restricted; use only operational rations. Unprotected fresh food stored in the open and close to the source of dissemination will become contaminated.

b. Detection.

(1) Rapid identification of agents used is absolutely essential to implement effective countermeasures. Agent identification must be achieved quickly; it is the first step in answering critical management questions. What adjustments must be made in food preparation and distribution? What are the essential countermeasures? What is the expected outcome of the incident?

(2) Samples of food that are suspected of being contaminated are transported to the designated supporting laboratory. Samples must be accompanied by a description of the samples, the sample collection procedures, and the circumstances which prompted the collection. The designated medical laboratory in the TO will provide a presumptive identification of the agent(s). Positive identification is accomplished by designated laboratories in CONUS.

c. Decontamination.

(1) Food contaminated with toxins is handled in the same manner as food contaminated with chemical agents. Food contaminated with microorganisms is handled in the same manner as when contaminated with the more common foodborne disease-producing microorganisms.

(2) Several methods are available to decontaminate food items contaminated with biological agents. The following decontamination methods **are considered to be the minimum.** See Table F-1.

(3) Group II food that is sealed in containers that are resistant to the passage of biological agents require only that the exterior of the container be decontaminated. Decontamination of these items are as follows:

(a) For containers made of metal, glass, plastic, or porcelain:

1. Thoroughly wash the container in potable water and soap, or in a disinfectant solution. If the water used for washing is contaminated, the soap and water wash may increase, not reduce, the contamination hazard. After which, the food containers are immersed in a disinfectant solution for 30 minutes (see Table F-3); then rinsed with potable water, if available and time permits. Chlorine solutions are not as reactive or corrosive as DS2.

2. Place the containers in boiling soapy water for 15 minutes; then rinse with potable water.

NOTE

1. The chemical field decontamination kits do not meet the requirements to decontaminate food supplies exposed to biological agents.

2. The same procedures should be followed even if there is only suspicion of a biological warfare attack.

(b) Thoroughly wipe containers that will not withstand soaking with a cloth soaked in a chlorine-detergent solution. Remove the food from the container and place it in Group III.

(c) Metal or glass containers determined to have trichothecenes (Yellow Rain) present can be decontaminated using DS2. Allow a contact time of 5 to 30 minutes for the DS2 to neutralize the toxin. Then rinse the container with potable water.

(4) Group III food items that are not protected by the packaging material are decontaminated or disposed of as follows:

(a) Decontaminate foods that can be peeled or pared by immersing them in a disinfectant solution for 30 minutes, and then rinsing them with potable water (see Table F-3). Peel or pare the items after decontamination, then wash and, if appropriate, cook before eating.

(b) With the exception of certain heat-stable toxins, heat is the most practical means of decontaminating food. Several heating methods may be used, but the method chosen depends upon the type of food to be decontaminated. The key is to apply as much heat as possible without rendering the food unfit.

1. Cook in a pressure-type cooker with 15 pounds of pressure at 250°F (121°C) for 15 minutes.

2. Cook in a low-pressure cooker at 228°F (109°C) for 1 hour.

3. Bake bread or related items at 400°F (204°C) for 40 minutes. Bread made with toxin contaminated flour (especially with trichothecenes) is still toxic.

4. Bake or roast meat at 325°F (163°C) for 2 hours.

5. Boil for at least 15 minutes when no other method is available.

(c) Although decontamination methods are provided above, vegetables such as lettuce, broccoli, and cauliflower, or unwrapped meats that have been exposed to biological agents should not be eaten.

(d) Foods, such as butter, ice cream, and bread, that will not withstand any of the above treatments must be destroyed.

(5) Established meat inspection procedures are followed when animals exposed to biological agents must be used for food. The meat must be thoroughly cooked.

Table F-3. Chlorine Solutions for Decontamination of Biological Warfare Agents

CHLORINE SOURCE	MIXTURE TO PRODUCE 200 PPM SOLUTION OF AVAILABLE CHLORINE
Household Bleach	1/2 gal/25 gal water
High-Test Hypochlorite (HTH) (Calcium Hypochlorite)	1/2 lb/25 gal water
Supertropical Bleach (STB)	1 lb/25 gal water

F-5. Chemical

a. Contamination.

(1) Contamination of foodstuffs by a chemical agent may occur at any point on the battlefield. This contact may render the food unpalatable also. In many cases, decontamination is difficult, thus, emphasis must be placed on protection. Keep food supplies covered at all times. Take special precautions to protect food that is not packed in protective packages. Unprotected food, forage, and grain supplies maybe so contaminated that their consumption will produce gastrointestinal irritation, or systemic poisoning. Nerve agents, vesicants, and arsenical are the most dangerous. Field concentrations of phosgene, hydrocyanic acid, irritants, and smokes will seldom be high enough to cause serious food contamination. The effect of CK on food is not known. As a precaution, foods exposed to CK should be considered toxic.

(2) The effects of chemical agents on food depend on the nature of the agent and the type of the food. The extent to which chemical agents penetrate food also depends on the amount, form of dispersal (liquid [droplet size], or vapor) and duration of exposure. Nerve agents and mustard will penetrate deeply into unprotected fatty foods and will readily penetrate granular products such as grain and sugar. Liquid food products can be completely contaminated. Arsenical readily hydrolyze to poisonous arsenical oxides in some foods. Foods can be divided into three categories based on their water content, fat content, and crystalline structure:

(a) Foods having a high water content, a low fat content, and/or a crystalline structure (fresh vegetables, fruits, sugar, salt, and eggs), will absorb mustard and nerve agents, either as a liquid or as a vapor. Nerve agents will be hydrolyzed slowly.

(b) Foods having a low fat content and an irregular (amorphous) structure (flour, bread, grain, rice, cereals, dried fruits, dried vegetables, tea, coffee, peas, and beans), readily absorb mustard and nerve agent in liquid form. As a vapor, these agents are absorbed to some extent, but are easily removed by airing.

(c) Foods having a low water content and a high fat content such as butter, fat, fatty oils, ham, cheese, milk, bacon, fatty meat, and fish, absorb mustard and nerve agents such that removal of the agents is virtually impossible.

(3) Chemical agents can be physically and chemically absorbed into food. In addition to the toxic effect, they often adversely affect taste, smell, and the appearance of the food. However, chemical agents can cause the food to become very toxic without causing any other changes in the food. Table F-4 shows the effects of a number of chemical agents on food. Since food can be contaminated without any outward change in appearance, the possibility of contamination must be assumed in a chemical agent environment. Treat the food with the same precautions as established for known contaminated items.

(4) The protective properties of packaging materials are dependent upon a number of factors. The factors include the form of the agent (liquid versus vapor); concentration and exposure time; weather (temperature, wind speed, and humidity); and packaging material (the type of material, thickness, and the presence of folds, tears, and small holes). Even the thinnest material will offer some protection and is better than nothing at all. Therefore, always cover food supplies with whatever material is available. Table F-5 summarizes the protection values of various packaging materials against vapors and liquids.

(a) Operational rations (B rations, T rations, and MREs) are substantially protected while contained in the shipping cases and especially if stored in the original palletized unit load with an overlay of fiberboard, shrink wrap, or film wrap. The worst case is pallets of subsistence contaminated by liquid droplets during an attack. After the attack, high vapor concentrations will exist in the vicinity of the palletized loads. If the outer barrier is permeable such as fiberboard, it is possible that a liquid agent can seep through the overlay fiberboard and contact the shipping containers in liquid form. Normally, with seepage resistant materials such as shrink wrap as the outer barriers, only the vapors of the agent are found within the pallet.

(b) While MREs are stored, the food is protected by up to six layers of material. Multilayer barriers result in a complex diffusion process of the agent from the outside towards the interior. Vapor penetration into nonhermetically sealed spaces is a simple gaseous diffusion process. Permeation through packaging is a much more complex process regardless of whether the challenge is a liquid or a vapor.

1. Liquid is adsorbed into permeable materials such as fiberboard or chipboard. With permeation-resistant materials (such as shrink wrap), the agent dissolves into, seeps through, then desorbs from the barrier material. Shrink wrap provides adequate protection. Fiberboard sheathing provides adequate protection against mustard agents, but not against nerve agents.

2. The low density polyethylene used to construct the menu bag can absorb chemical agents and possibly toxins. If the menu bag is removed from the shipping container and is exposed to liquid contamination, enough agent may pass through the bag to create a health hazard. Keep MREs in the shipping container until issued to the soldier. The menu bags should then be kept under the same degree of protection as the soldier.

3. The aluminum laminated materials used to construct the MRE (retort and nonretort) pouches protect food from chemical contamination if hermetically sealed. The only item in the MRE meal bag that is not adequately protected is the spoon.

(5) Mylar and cellophane are resistant to chemical agents.

Table F-4. Effects of Chemical Agents on Food

AGENT	INFLUENCE ON TASTE	SMELL	COLOR	RESIDUAL TOXICITY
Mustard	Bad	Bad	Discolors meat	+
N-Mustards	Bad	Bad	Doesn't discolor meat	+
Arsenicals	Acid	Bad	Discolors meat and vegetables	+, Arsenic
Nerve Agents	Bad	None	None	+
Phosgene	Acid	None	?	- After weathering
Cyanogen Agents	Bitter	Bad	None	- After weathering
Irritants	Acid	Bad	None	+
Smoke	Acid	Bad	?	-
White Phosphorous	?	?	?	+

\+ Indicates the presence of residual toxicity.
\- Denotes that residual toxicity is not present.
? The influence has not been determined.

Table F-5. Protection from Chemical Contamination by Packaging Methods and Materials

	CHEMICAL VAPORS	LIQUIDS
BOTTLES AND CANS		
Airtight Bottles	Complete	Complete
Sealed Metal Cans	Complete	Complete
Glass Bottles	Good	Good
Metal Containers	Good	Good
BOXES		
Cardboard	Moderate	Moderate
Wooden Crates	Moderate	Poor or None
WRAPPINGS		
Metal Foil Laminates	Complete	Complete
Paper	Poor	None
Textiles	None	None
Waxed Paper	Good	Moderate
Multilayer Bags	Good	Moderate
Cellophane	Good	Good
Cellophane, Wet	None	None
Canvas	Poor	Poor

b. Detection.

(1) Currently, a field method for detecting chemical agent contamination in food does not exist. Contamination is not always spread evenly throughout food; this makes it impossible to take a single sample and determine the presence or absence of chemical agents in the entire lot. Additionally, standardized laboratory tests have not been developed for determining levels of chemical agents in food. Until a specific method to detect chemical agents in food is available, reliance will have to be made upon determination of contamination, or lack thereof, on the packaging material; the integrity of the packaging material; the protective qualities of the packaging material; and the penetration characteristics of the suspected chemical agents.

(2) Food may become toxic without any change in outward appearance. Never taste or smell food to determine if contamination is present in food.

(3) Veterinary and subsistence units have the following equipment available to detect chemical agents in the field:

(a) The M8 Automatic Chemical Agent Alarm System consists of the M43 detector unit and the M42 alarm unit. The detector unit is a portable, automatic, point-monitoring device that is designed to be hand carried from point to point. The M8 is used to provide early warning of a toxic agent position and detects the presence of chemical vapors and aerosols. The M43 detects all nerve, blood, and choking agents, and some blister agents. The M43A1 (the replacement for the M43) only detects nerve agents.

(b) The M256 Chemical Agent Detector Kit detects and identifies nerve, blood, and blister agents. The M256 is the most sensitive of the chemical agent vapor detectors available. However, it is not a continuous, real time monitoring system. It requires 15 to 20 minutes for sampling and analysis.

(c) The ABC-M8 VGHChemical Agent Detector Paper can detect and differentiate between nerve and blister agents by color change. It is intended to be used by blotting and wiping surfaces suspected of contamination. The M8 paper will respond with a visual color change in 10 seconds or less.

(d) The M9 Chemical Agent Detector Paper will detect liquid nerve (G & V and blister agents (H & L), but will not identify the specific agent or differentiate between nerve and blister agents. The M9 tape is sensitive to droplets as small as 100µ, and will respond with a visual color change in 10 seconds or less.

(4) All subsistence in a chemical attack area are considered contaminated until a survey can be conducted, preferably by veterinary and chemical personnel. Personnel must be at MOPP Level 4 while conducting the survey. Concentrate the initial portion of the survey on the adequacy of the storage facility and other protective measures in preventing chemical agent contact with subsistence items. The area surrounding the storage facility is examined for the presence of animals, rodents, birds, and arthropods acting unusual, or dead in unusual numbers. If animals are present and assistance is required in identifying the NBC agent, specimens can be collected and submitted to the AML. Damage such as broken windows, holes, or loss of structural integrity of the storage facility is noted. This information combined with knowledge of the agent form (liquid or vapor), type of agent (which will indicate the degree of persistency), and approximate time of attack will provide a risk assessment. Liquid agents should not significantly penetrate an intact facility, but may produce vapor contamination by offgassing.

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(a) Upon entering the storage facility, the M8 can be used to determine the presence of chemical vapors. However, precautions must be taken. The M42 alarm is not to be used inside shelters, vehicles, vans, or other interior modes. Therefore, when checking food storage facilities, the alarm unit must be left outside, turned off, or disconnected. Do not tilt the M43 detector more than 45 degrees (because of the liquids it contains). This is not a problem with the improved M43A1, but the M43A1 requires attachment of an exit port filter when used indoors. The M256 Chemical Agent Detector Kit can be used to sample the air.

(b) Pre-position M9 chemical agent detector paper in food storage areas; especially on the least protected pallets and in areas where droplets may enter, such as near doors or windows. Examine the M9 paper for indications of liquid chemical agents. If the M9 paper is positive, or if the packaging materials show the presence of liquids or stains, use the M8 detector paper to determine the type of the agent. If an agent is not indicated by the detector paper, then the amount of agent present will be insufficient to cause secondary contamination when the outer package is removed.

(5) Detection procedures become more complicated if a chemical agent has penetrated or permeated through the packaging and packing materials. Unless liquid has seeped through the cardboard, any agent in the interior of the shipping case will be in a vapor form. Liquid seeping should be obvious. The sampler-detectors in the M256 Chemical Agent Detector Kit do not have an aspirator for sampling the interior of the case. However, there are several procedures that can be used. One is to open the case, place the activated sampler-detectors inside the case, and then reclose the case. Another is to punch holes in the case, place the activated sampler-detector over the holes, and cover the sampler-detectors with an empty box or can (open end down) to concentrate the vapors escaping from the case. Alternatively, remove the food from the case and place it in a plastic bag with the sampler-detectors to concentrate the vapors. These procedures require two sampler-detectors; one for blood agents and one for nerve and blister agents. Neither method is very sensitive in low concentrations of vapor as is expected to be present inside shipping containers. A better method is to modify to M43 detector with a field expedient probe of Teflon tubing attached to the detector's air inlet. Insert the open end of the tubing into a hole in the case or package to sample the interior air. When available, the CAM can be used; its design will allow aspiration of air from inside shipping cases. The CAM can also be used to detect and identify liquid agents on a surface provided the agent is vaporizing in sufficient quantity. The CAM gives a visual representation of a hazard evaluation.

c. Decontamination.

(1) Decontamination is only required for contamination remaining 10 minutes or longer. Decontamination efforts on subsistence items will normally be limited to removal of the containers and carton overwrap material.

(2) The need for decontamination is primarily dictated by the type of chemical agent used. The method of decontamination selected will depend upon the type of packaging material used and the urgency with which the food is required.

(3) Food supplies in storage are not likely to be seriously contaminated if reasonable protection precautions are taken. For this reason, large supplies of food are not to be condemned as a whole simply because they have been exposed to possible chemical contamination. A prompt and careful survey of the supplies may reveal that only a few items have been contaminated to a level that decontamination is required. Prompt segregation of the heavily contaminated portions will prevent, or minimize contamination of the remainder. Foods without protective packages constitute the major difficulty.

(4) Individual decontamination is performed by each soldier on those subsistence items in his possession at the time of the attack. Individual decontamination is limited to operational rations that are in original, intact containers. Unit-level decontamination is performed by unit personnel under the supervision of unit NBC personnel. Support decontamination is attempted at major subsistence storage facilities. Again, decontamination is limited to packing material. Decontamination of food itself is only attempted in emergency situations when alternative supplies are not available.

(5) Start decontamination operations with the easiest method and proceed to the most difficult. This allows for the removal of a relatively large portion of the contamination in a minimum of time. The simplest procedure is to allow the materials to age and air ("weather"). Substantial self-decontamination will occur with most agents. Exception are thickened mustard, thickened GD, and VX. Table F-6 provides the length of time for which contaminated subsistence supplies may present a contact hazard. Weather elements that affect decontamination are—

(a) Warm temperatures speed liquid agent offgassing and hasten the dispersion of chemical agents into the air.

(b) High winds rapidly disperse chemical agent vapors and speed offgassing from surfaces.

(c) Moisture causes chemical agents to react with water to form nontoxic or less toxic chemicals. Heavy rain or rain of long duration can aid decontamination by mechanically removing chemical agents.

(d) Even in cold weather, direct sun rays warm surfaces above the air temperature and hasten the offgassing and decomposition of chemical agents.

Table F-6. Persistency of Selected Liquid Chemical Agents

AGENT	WEATHER CONDITIONS		
	SUNNY, AROUND 20°C, LIGHT BREEZE	WET AND WINDY, AROUND 10°C	CALM, SUNNY, LYING SNOW, AROUND -10°C
Mustard (HD)	2 - 7 days	1/2 - 2 days	2 - 8 weeks
Tabun (GA)	1 - 4 days	1/2 - 6 hours	1 day - 2 weeks
Sarin (GB)	1/4 - 4 hours	1/4 - 1 hour	1 - 2 days
Soman (GD)	2 1/2 - 5 days	3 - 36 hours	1 - 6 weeks
Nerve (VX)	3 - 21 days	1 - 12 days	1 - 16 weeks

(6) Active decontamination is attempted only when weathering will not decontaminate the packaging material in sufficient time. Decontamination procedures can be enhanced by using heat to vaporize the chemical agent; by reaction with decontaminants; or by removing with hot soapy water.

(a) The simplest (standard) decontamination materials are water and detergents. An effective decontaminant is hot water used with the addition of soap or detergent and *scrubbing.* Commercial abrasive powdered cleansers are effective decontaminants for many surfaces (metal, glass, Formica), but not wood or soft plastics.

(b) Water can be used to flush chemical agents from surfaces. High-pressure application produces a better cleansing action than low pressure. If the surface has absorbed the agent, flushing will remove the surface contamination, but will not affect the agent that is absorbed.

(c) Soaking contaminated items in boiling water is an excellent decontamination method for some agents. Water alone will not be sufficient to decontaminate all chemical agents. Soaking in warm or cold water may reduce the contamination slightly; however, the hazard may not be reduced sufficiently even after prolonged soaking. If hot water is not available, or if it might cause damage to the item, other methods of decontamination should be considered, such as decontaminating solutions or a caustic solution followed by thorough rinsing.

(d) Fibrous materials such as cloth and canvas are best decontaminated by washing and scrubbing.

(e) Glass, metal, porcelain, and plastic surfaces are best decontaminated by using hot water or hot soapy water. Some toxic materials are readily removed with no more than slight abrasion or brushing.

(f) Painted, varnished, and waxed surfaces are generally smooth and nonporous. Dust and liquids are readily removed by wiping, brushing, or vacuuming. Absorbed materials are removed by hot water, detergent, or completing agents. None of these surfaces stand up well to heavy abrasive techniques. Agents can be attacked and removed by caustics, acids, and organic chemicals. Some of these surfaces readily absorb agents, so weathering following decontamination is advisable.

(g) Rubber is a porous material that can absorb agents. It is not easily decontaminated by abrasive techniques. Warm, soapy water used with brushing is effective since it removes some absorbed contamination. Strong acids, alkalies, and organic solvents may deteriorate and decompose rubber articles.

(7) Operational rations are the primary rations issued; always issue uncontaminated stocks first. This allows for decontamination of contaminated stocks without interrupting supply support. Normally, contaminated stocks are not issued. The decision to issue contaminated items is based on the tactical situation, criticality of the items, type and extent of contamination, and the time and resources available for decontamination. Decontamination efforts on subsistence items are limited to the containers and carton overwrap material.

(a) The MRE retort and nonretort food pouch may be decontaminated with soap and water wash. The chemical agents will be removed by the solutions.

(b) Semipermeable materials (polyethylene menu bag, shrink wrap, and film wrap) may have chemicals deposited not only on the surface, but also dissolved into the matrix of the material. The chemicals can be removed from the surface by washing with hot soapy water, but contaminant dissolved in the material is not removed. The remaining agent can only be removed by weathering which can be accelerated through the use of heat and sweeping the surface with air.

(c) Fiberboard is both sorbent and permeable and acts like a blotter. Liquid decontaminants can force the contaminant further into the fiberboard. Any attempt to decontaminate fiberboard would be futile. The only alternatives are to remove the fiberboard, or to allow it to weather.

(d) Palletized unit loads of MRE outerwraps can be decontaminated through the aid of a forced clean air sweep in 4 to 5 days, compared to 3 weeks or more under natural conditions without a forced air sweep.

(8) Contaminated food supplies are only handled by personnel trained in decontamination methods and in MOPP Level 4. Contaminated food items are divided into three groups as described below (see Table F-1 for additional information).

(a) Group I consists of canned and unopened packaged items which have been exposed only to agent vapors. Most items in this group will be safe to issue after a brief period of outdoor airing to remove clinging vapors. Table F-7 lists the decontamination procedures for packaging materials contaminated with nerve agents, mustards, and arsenical.

Table F-7. Chemical Decontamination of Packaged Material

PACKAGING MATERIAL	CONTAMINATION	DECONTAMINATION PROCEDURES
Airtight metal containers, glass bottles, foil aluminated laminated materials.	Vapor and Liquid	Air for 24 hours. Wash with hot soapy water, soda, or bleach solution. Rinse with water.
Polyester, PVF, wooden boxes, crates, board, multilayer bags.	Vapor	Remove contaminated package. Air contents for 24 hours.
Cardboard, polyethylene.	Liquid	Contaminated contents—treat as unpackaged food.

(b) Group II consists of canned and unopened packaged items which have been contaminated with a liquid chemical agent.

1. Attempts to decontaminate porous packaging materials, such as cardboard or wood, are likely to be unsuccessful and may result in spreading the contamination. The best procedure in handling such items is to strip off the outer contaminated coverings and examine the inner layer to see if penetration of the agent has occurred. If it has, continue stripping off layers until an uncontaminated layer is reached and place it in Group I. If the agent has penetrated to the food, place it in Group III.

2. Food in cans or in other sealed, impermeable containers is not in danger of chemical contamination. Because contamination is confined to the outer surface of the sealed

container, decontamination is accomplished by: immersion in boiling, soapy water for 30 minutes and rinse; immersion in boiling water for 30 minutes; spray with DS2; or to wash in hot soapy water, rinse, and aerate. Under no conditions should contaminated containers be opened before they have been decontaminated and monitored.

3. Supertropical bleach and DS2 can be used on the polyethylene menu bag for up to 24 hours without a significant change in appearance, tensile properties, and size of the plastic. The use of DS2 will cause significant degradative changes to most other plastics, while STB will cause little or no change. Also, DS2 may cause false positive readings when using M8 or M9 paper, or the M256 Detector Kit to check completeness of decontamination.

(c) Group III will consist of unpackaged or poorly packaged items which have been exposed to an agent in either vapor or liquid form. Foodstuffs in this group should be decontaminated only when absolutely necessary. **The decision to use foods that have been contaminated is to be made by the commander.** Decontamination procedure to be followed, in order, is: trim surface fat and grossly contaminated areas; wash with water or 2-percent sodium bicarbonate solution; then boil in water.

1. Boiling in water may be eliminated when the contamination has been only with the vapors of irritant agents. When such an exposure has been light, aeration for a short time may be used for decontamination.

2. Frying, roasting, or broiling will not remove traces of blister agents from meats. In general, salvage of foods heavily contaminated with droplets of the blister agents, especially the arsenical blister agents, is not practical. Foods of high water or fat content are unfit for consumption and reclamation is not practical when contaminated with liquid mustard or a liquid nitrogen mustard.

3. When foods have been exposed to blister agent vapor, they can be reclaimed by washing with sodium bicarbonate solutions and rinsing with clear water, by intensive cooking, or in the case of dry provisions, by 24 to 48 hours of aeration. Lean meat contaminated with mustard vapor can be reclaimed by boiling in water for 30 minutes or more. With nitrogen mustard vapor contamination, the meat should be boiled in a 2-percent sodium bicarbonate solution. Discard the water used to boil the meat.

4. Nerve agent contamination is treated the same as blister agent contamination.

5. Food such as potatoes and hard-skinned fruits and vegetables can be decontaminated by washing or scrubbing, followed by peeling or scraping, then washing again.

6. Prepared food in open containers will be contaminated; it must be temporarily isolated, or disposed of (bury or as directed by commander).

7. A food item that is contaminated with irritants can be decontaminated by airing. Consumability is determined by taste rather than toxicity.

8. Phosgene is rapidly hydrolyzed, therefore, washing the food with water or airing it will usually suffice.

9. Food contaminated with white phosphorous should be destroyed.

10. Normally, hydrocyanic acid will have little effect on food supplies. The exposures will most likely be as a vapor. However, foods with a high water content may become unfit for consumption after exposure to high concentrations.

11. The effect of CK on foods is not known. Foods exposed to CK vapors are considered toxic.

12. Table F-8 lists the decontamination procedures for unpackaged food contaminated with a chemical agent.

(9) Decontaminating cattle, poultry, and other livestock is only attempted when other sources of food are not available. Heavily contaminated animals should be destroyed. Livestock contaminated lightly by phosgene, nerve agents, mustards, and arsenical (such as vapor or liquid) may be slaughtered in the early stages of poisoning before the full effects of exposure are shown. If these animals are slaughtered in the preliminary stages of poisoning and all tissues exposed to the agent (the head, blood, lungs, organs, and local areas) are discarded, there is no danger in consumption of the meat, provided the animal passes a pre-slaughter and slaughter inspection. This is true even of animals poisoned by arsenical agents since the edible tissue will contain amounts of arsenic too small to be toxic. Organs (liver, brain, heart, kidney, and lungs) will contain more arsenic than the musculature and are discarded. The meat must be well cooked. Personnel involved in slaughtering procedures must be careful to prevent spreading contamination to the meat and to themselves.

(10) Decontaminating forage and grain exposed to only chemical agent vapors is by aeration. Aerated supplies, especially if mixed with larger amounts of uncontaminated supplies, produces no ill effects when fed to animals. Forage or grain heavily contaminated by liquid vesicants, especially arsenical, should not be used.

Table F-8. Chemical Decontamination of Unpackaged Food

CHEMICAL AGENT	FATTY FOODS (BUTTER, BACON, MILK, CHEESE, HAM)	NONFATTY FOODS, HIGH WATER CONTENT, CRYSTALLINE (FRUITS, VEGETABLES, SALT, SUGAR)	NONFATTY FOODS, LOW WATER CONTENT, AMORPHOUS (FLOUR, CEREALS, BREAD, PEAS)
NERVE AGENTS			
Vapor, Heavy	Destroy	Destroy, unless possible to boil after airing 48 hours.	Air for 48 hours, then boil.
Vapor, light	Destroy	Air for 48 hours, then boil.	Air for 48 hours,then boil.
Liquid	Destroy	Destroy	Destroy
MUSTARDS			
Vapor	Remove 1-3 cm of outer layer and wash with 2% sodium bicarbonate solution. Boil for at least 30 minutes. Destroy milk.	Wash with water, air for 48 hours.	Wash with water. Air for 48 hours.
Liquid	Destroy	Destroy	Destroy
ARSENICALS	Destroy	Destroy	Destroy

★ APPENDIX G

BIOLOGICAL SAMPLE/SPECIMEN COLLECTION AND MANAGEMENT

G-1. General

a. Critical elements for accuracy in analysis of biological samples and physiological specimens are correct collecting, packaging, handling, and transporting techniques. The quality of any analytical evaluation is directly related to the quality of the sample/specimen and the degree of postcollection degradation that occurs prior to testing. Combat health support personnel collect and submit specimens for suspect NBC hazards/agents involving humans and animals. Chemical corps and other nonmedical units collect and submit environmental (air, plant, and soil) samples for suspect NBC hazards/agents. Preventive medicine personnel collect and submit water and ice samples for suspect NBC hazards/agents. Veterinary personnel collect and submit food samples, such as fruits and vegetables; and specimens from animals for suspect NBC hazards/agents. Specimens collected by clinical laboratory personnel from inpatients at an MTF that are suspect of being exposed to a biological agent are forwarded to the supporting laboratory (such as the AML, theater Army medical laboratory, Navy land-based laboratory) personnel.

b. Essentially all military operations, (war, multinational deployments, military contingency operations, peacekeeping, peace enforcement, humanitarian support missions, and civic action programs) may generate some laboratory testing requirements. Each scenario, geographical region, population base, and suspect agent will impact on the type and amount of samples/specimens required and the collection process. During all operations, express permission is required before collecting specimens from civilians because of religious or sociological beliefs in many cultures. To obtain such specimens without permission could result in unnecessary mission complications.

NOTES

1. The term “sample” refers to nonhuman and nonanimal origin. The term “specimen” refers to human and animal origin.

2. Always consider that chemical agents may have been employed. You must check for chemical agents before collecting the sample/specimen. Chemical agents can damage or destroy biological agents. Also, chemical agents not identified in the sample/specimen can pose a hazard to receiving laboratory personnel. Mark all samples that are potentially contaminated with chemical agents as such.

3. Precautions should be taken to protect the sample/specimen collector from potential BW agents; at a minimum, respiratory protection and rubber gloves must be worn. Additional care must be taken when collecting samples/specimens to prevent cross-contamination. Gloves must be changed or decontaminated between sample collections.

4. Samples will not be delivered to the clinical laboratory of an MTF for analysis. They must be delivered to the designated supporting laboratory for processing. This will prevent the potential of accidentally spreading a biological agent in the MTF.

NOTES *(Continued)*

5. Prepare DA Form 4137 (Evidence/Property Custody Document). This form must accompany the samples/specimens from the point of collection to the final receiving laboratory. Each person receiving the sample/specimen must sign the document to provide evidence of chain of custody at all times.

c. Coordination for follow-on testing is absolutely critical to the sample/specimen collection process. The quantity, type, preservation, and acceptable delay in the time from collection to testing should be established before any sample/specimen is collected; otherwise, the effort may be compromised (to the detriment of both the individuals concerned and the authority awaiting the results).

d. Coordination with the receiving laboratory should be made to establish sample requirements, preferred collection techniques, methods of preservation, and transportation conditions, when the tactical situation and/or mission permits.

e. The number of individuals that need to be sampled varies with the type of analysis performed and the impact of the values determined.

- The number and types of individuals that need to be sampled, as well as the types of samples/specimens required, is determined by the analytical needs of the testing facility and the nature of the information required.

- Analysis to predict the prevalence, incidence, and impact of health hazards will be coordinated by the Epidemiology Section of the supporting laboratory. Their expertise and data analysis capability will guide the sample/specimen procurement process to best meet the requirements of each particular scenario.

- The number and types of "control" samples/specimens required to validate test information is determined by the supporting laboratory personnel. Random sampling, matched control populations, or other techniques will be employed as the requirements are identified.

- Confounding variables, interindividual variance, time-sequence significance, and other factors affecting analytical results are evaluated by the testing facility to predict their impact on results. The need to compensate for such variables is determined by supporting laboratory personnel; sampling methods are adjusted accordingly to mediate their impact as much as possible.

- Before submitting physiological samples/specimens to a laboratory for analysis, coordination with the receiving laboratory is essential. Most routine sample/specimen requirements can be verified through SOPs and submission manuals, but unusual or unique situations normally require direct contact with the testing laboratory to confirm the number and types of samples/specimens required to effect an accurate analytical process.

G-2. Sample/Specimen Collection and Preservation

a. Antemortem Specimens. Physiological specimens from living human or animal patients can include just about any conceivable body source or excreted by-product. It must be noted that

specimen types are seldom interchangeable; the exact type and amount of specimen required for a specific assay must be known before a collection procedure is initiated (see FM 3-19).

- Patients seen in an MTF may be a source for specimens suspected of containing biological agents. The primary medical care provider will determine the level of treatment for these patients and the specimens required for laboratory diagnosis. The MTF laboratory is not equipped to handle biological agents and therefore specimens generated will be forwarded to the supporting laboratory for analysis. Patient disposition will be based on evacuation policies, exposure, suspect agent, clinical symptoms, and required treatment/isolation.

- Blood specimens represent the most common analytical sample. Certain techniques and special care must be exercised to ensure an acceptable specimen is collected and to minimize an adverse affect to the patient or specimen collector. In general, phlebotomy requires the use of a 20 to 22 gauge needle to minimize mechanical hemolysis during aspiration using a syringe or Vacutainer™ tube collection system. Blood collected with a syringe and needle should be transferred to an appropriate Vacutainer™ tube immediately after collection. The type of tube, type of anticoagulant or preservative, and amount of blood collected will vary with the specific assay requested. Unless some special sample preparation step is required, the blood is best left in the original rubber-stoppered tube for transport.

- Urine specimens are best collected using a clean-catch (midstream, if possible) technique in a sterile urine cup. The volume of sample required will vary depending on the specific assay requested; however, 25 to 50 ml is sufficient for most tests.

- Tissue specimens can originate from any body source accessible by scrapping, swabbing, or minor excision. Tissue specimens are collected by medical personnel trained for this task. Specific techniques for collecting these specimens are not provided in this appendix.

NOTE

In cases where the supporting laboratory cannot be contacted, as a minimum the following specimens should be collected: Urine—25 to 50 ml in a sterile container. Blood—two 7 to 10 ml tubes without anticoagulant (red-stoppered Vacutainer™); two 7 to 10 ml tubes with potassium or sodium EDTA (lavender-stoppered Vacutainer™).

- All specimens (regardless of physiological source) must be labeled to positively identify the individual or animal from whom it was collected; at a minimum, the individual's full name, unique personal identification number (SSN when possible), military unit and location, and date and time of collection should be written on the label of the specimen container.

- All specimens are collected using aseptic techniques. All specimens are packaged, handled, and transported in a manner that ensures they arrive at the final destination laboratory in a testable condition. Personal protection guidelines must be adhered to when collecting or processing specimens; at a minimum, this includes gloves and a mask. In the laboratory, a gown or other protective items may also need to be used. In the field, under suspect NBC conditions, collectors

should be in MOPP4 or inside NBC-protected vehicles. Common sense and the clinical and/or tactical situation will determine the extent of personal protection necessary.

- Preservation of specimens, either chemically or mechanically (cooling), will be necessary to minimize the amount of analyte degradation that occurs after removing the specimen from its physiological microenvironment. The optimal preservation technique will vary with different laboratory tests and must be confirmed for each requested assay. While freezing may preserve some serum constituents, freeze-thawing cycles may denature others. Freezing may also completely destroy certain microorganisms. This caution also applies to tissue specimens since "fixing" tissue with a standard 10 percent formalin solution will preserve tissue for special staining techniques; however, it renders the specimens completely useless for microbiological culture. Always verify specimen preservation requirements for storage and transport with the supporting laboratory before processing the specimen. Ideally, confirmation of the correct handling conditions should be coordinated before collection.

- The importance of coordinating sample/specimen collection with the supporting laboratory facility cannot be overstated. Contact the receiving laboratory for instructions when doubt exists about the appropriate source, collection technique, storage and preservation conditions (such as, aerobic or anaerobic environment), and transportation requirements for samples/specimens. Extremely small volumes of samples/specimens, properly collected and handled, can yield a tremendous amount of information to assist in making medical, tactical, and strategic decisions. Conversely, very large quantities of poorly collected and insufficiently preserved samples/specimens are essentially worthless for most analytical techniques.

- Analysis beyond intratheater capabilities will be coordinated by the supporting laboratory, when deployed, or through medical channels in the absence of an in-theater supporting laboratory.

b. Postmortem and Forensic Specimens. The analysis of specimens from deceased humans and animals can provide valuable information about the disease, organisms, injuries, or environmental conditions at the time of death. This information can greatly enhance the treatment of others affected by the same, or physiologically similar, process. Specimen collection for postmortem or forensic examination is very important; the techniques involved reflect a significant degree of training, experience, and skill.

(1) The collection of specimens from remains should be conducted exclusively by a pathologist, or other personnel specifically trained in forensic collection techniques. An exception is when SOF personnel are operating under radio silence conditions; the most qualified medical person with the operation collects, preserves, and transports or coordinates transport of specimens for evaluation. The same chain of custody requirements apply to specimens collected by SOF personnel, as with all other specimens.

(2) A large amount of support information can be gained by analyzing the site of injury and subsequent death. This "site scene" investigation requires a tremendous attention to detail and a trained observer. If forensic personnel cannot be contacted, or will be unduly delayed in arriving at the scene, then photographs of the victim and the immediate surroundings should be made. The scope and extent of the photographs should be composed to reflect as much detail as possible to assist forensic personnel in reviewing the scene retrospectively. In the event that photography is not feasible, detailed sketches of the scene should be made to assist the forensic investigation.

(3) Techniques such as cardiac or bladder puncture, needle biopsy of organs, spinal tap, or exploratory laparotomy should not be performed by untrained personnel unless specifically requested and directed by forensic investigators.

c. Water Sample Collection.

(1) Water samples for identification or verification of biological agent contamination are collected by PVNTMED personnel. The supporting laboratory should provide guidance on sampling procedures and collecting kits for use in collecting the samples. In the absence of guidance, a technique for use of the Sep-Pak is described in FM 3-19.

(2) When sampling kits are not available, samples may be collected in other available containers. The containers must be sterile. The best containers for use are the 100 ml glass bottles used for collecting routine water samples. All water samples must be collected and placed in a cooler or refrigerator until the sample is transported to its destination. During transportation the samples must be maintained at a temperature between 1^0C and 4^0C.

d. Food Samples. Veterinary personnel must collect suspect biologically contaminated food samples for submission to the supporting laboratory for in-theater verification of contamination. All food samples must be collected and placed in sterile containers. Place the samples in a cooler or refrigerator until the sample is transported to its destination. During transportation the samples must be maintained at a temperature between l^0C and 4^0C.

e. Environmental Samples. Environmental samples are collected as directed in the operators' manual or other publications for operating collection systems. Example: The Biological Integrated Detection System (BIDS) collects an environmental sample using a single liquid sample collector. The collector is a high-volume aerosol sampling and collection device. On demand it samples ambient air through a two-stage virtual impactor which concentrates aerosol particles in the 2 to 10 micrometer diameter size range. The concentrate particle stream is directed through a wet collector containing a buffer solution and over a 45 minute period a 40 to 50 ml sample is collected. On order or when test results indicate a suspected agent, the sample and associated documentation are packaged and transported IAW FM 3-101-4, Appendix H (Biological Detection Platoon Operations; Sampling, Handling, and Chain of Custody).

f. Chain of Custody.

(1) A strict chain of custody must be maintained for every sample/specimen collected. Use DA Form 4137 (Evidence/Property Custody Document) for each sample/specimen collected. The DA Form 4137 must accompany the sample/specimen during transport from the point of collection to the final receiving laboratory. Each time the sample/specimen is transferred to another individual, the receiving person must sign the document to show that they received the sample/specimen. The document will provide the answer to the following questions:

- When was the sample/specimen collected?
- Who has maintained custody of the sample/specimen?
- What has been done with the sample/specimen at each change of custody?

(2) The samples/specimens must be appropriately packaged, labeled, and evacuated to the designated laboratory for confirmation of a biological attack. The standard chain of custody for the evacuation would be as follows:

- Sampling unit.
- Unit S2 or medical operations officer.
- Technical Escort Unit or other command-designated escort personnel.
- In-theater laboratory, if in operation.
- Technical Escort Unit or other command-designated escort personnel.
- CONUS laboratory.

G-3. Sample/Specimen Transport

Samples/specimens submitted for laboratory analysis must be properly packaged, labeled, and shipped to ensure they arrive in an analytically acceptable condition. All samples should be maintained at a temperature of 1°to 4°C during transport. Ideally, samples/specimens should arrive at the in-theater laboratory within 6 hours of collection. The samples/specimens should be delivered to the CONUS laboratory within 24-48 hours. If the samples/specimens cannot be delivered to the CONUS laboratory within this time, then they should be flash frozen to -165°C, if capabilities are available. Dry ice should be used when flash freezing cannot be accomplished, if available. If the samples/specimens cannot be delivered to the CONUS laboratory within 24 hours, the supporting laboratory should subculture the samples/specimens. The supporting laboratory should send the subculture with the samples/specimens to the CONUS laboratory. The subculturing date should also be provided.

a. Coordination must be made with Technical Escort Unit personnel for transporting the samples/specimens to the laboratory. When these personnel are not available, a chain of custody must be established and personnel designated with the responsibility for escorting the samples/specimens to the supporting laboratory and on to the CONUS laboratory. Regardless of who escorts the samples/specimens, a documented chain of custody must be maintained.

b. All samples/specimens should be sealed in plastic bags, or other containers to prevent leakage during transport. The containers must contain sufficient absorbent material to absorb the entire contents in the event of a leak. This minimizes the risk of contamination to escort and laboratory personnel. The sample/specimens must be packaged in an International Air Transportation Association (IATA) -approved sample transport container for shipment/delivery to the CONUS laboratory. If an IATA sample transport container is not available, ice (wet or dry depending upon required temperature) may be used for initial packaging and transport in-theater. However, the ice must not be in direct contact with the samples/specimens; place the ice in plastic bags, or other such material, to cool the samples/specimens during transit. Conversely, the samples/specimens (or packing container) may need to be insulated to minimize temperature extremes during shipping. However, for-transport out of theater, the samples/specimens must be packaged in an IATA-approved container.

c. The chemical composition of samples/specimens can rapidly deteriorate when exposed to excess heat, solvents, sunlight, and even ambient air. Likewise, microorganisms may not survive even relatively short periods of time if not kept at the correct temperature and, optimally, contained in a supportive transport medium. Instructions for packaging and transport conditions should be

obtained from the supporting laboratory facility. Special transport medium, if necessary, is requested from the supporting laboratory when it is not readily available to the collecting unit.

d. As mentioned previously, accurate and complete sample/specimen identification is necessary. An adhesive label on the primary sample/specimen container is best, along with a list of all samples/specimens packaged in a secondary transport container, if more than one sample/specimen is being shipped.

e. A short written narrative of the facts, circumstances, and conditions generating the samples/specimens should be included with the shipment. Include the collector's name, unit, and telephone number (if available), and the grid coordinates of sample collection point. This provides useful information to the laboratory investigators; it can guide them in expanded or follow-on testing.

f. Samples/specimens will not be split prior to arrival at the first receiving laboratory. The initial receiving laboratory will extract the required amount (an aliquot) of sample/specimen for their use. The laboratory is equipped to extract portions of the sample/specimen while preventing cross-contamination (introduction of contamination at the time of splitting) of the sample/specimen. This will ensure that valid samples/specimens arrive at the CONUS laboratory for confirmation of use of biological warfare agents; thus providing the National Command Authority with required confirmation.

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GLOSSARY

ACRONYMS

ABO agents of biological origin

AC hydrogen cyanide

AMEDD Army Medical Department

AMEDDC&S Army Medical Department Center and School

AML area medical laboratory

AN/PDR27 radiacmeter

AN/VDR2 radiacmeter

AO area of operations

AR Army regulation

ATM advanced trauma management

ATTN attention

BAS battalion aid station

BDU battle dress uniform

BSA brigade support area

BW biological warfare

BZ an incapacitating agent

C Centigrade

C-1OO environmental control unit for DEPMEDS

C^3 command, control, and communications

Cal/cm^2 calories/square centimeter

CAM chemical agent monitor

CANA convulsant antidote for nerve agent (diazepam)

CB chemical/biological

CBPS chemical, biological, protected shelter

CG phosgene

cGy centigray

CHEMWARN chemical warning

CIR commonwealth of independent republics

CK cyanogen chloride

CL chlorine

CLS combat lifesaver

cm centimeter

cm^2 square centimeter

CNS central nervous system

$C0_2$ carbon dioxide

COMMZ communications zone

CONEX container express

CONUS continental United States

CPS collective protection shelter

CS combat support

CSC combat stress control

CSH combat support hospital

CSS combat service support

CW chemical warfare

CX halogenated oximes

DA Department of the Army

DAP decontamination apparatus, portable

DCS division clearing station

DE directed energy

decon decontamination

DEPMEDS Deployable Medical Systems

DMSO division medical supply office

DOD Department of Defense

DP diphosgene

DSA division support area

DS2 decontaminating solution number 2

DTF dental treatment facility

ECU environmental control units

EMP electromagnetic pulse

EMS emergency medical services

EMT emergency medical treatment

EPW enemy prisoner of war

evac evacuation

F Fahrenheit

FLD field

FLOT forward line of own troops

FM field manual

FMC Field Medical Card

G2 Assistant Chief of Staff (Intelligence)

GA tabun

gal gallon

GB sarin

GD soman

gm gram

GP general purpose

HD mustard

HL mustard and lewisite mix

HMMWV high mobility multi-purpose wheeled vehicle

HN nitrogen mustard

HSS health service support

HSSPLAN health service support plan

HTH high test hypochlorite (70% available chlorine)

ID incapacitation dose

ID50 infectious dose to 50 percent of exposed individuals

IR infrared

IS0 International Organization for Standardization

IV intravenous

kg kilogram

km kilometer

kph kilometers per hour

KT kiloton

L lewisite

lb pound

LBE load bearing equipment

LD 50/60 lethal dose for 50 to 60 percent of exposed individuals

LSD lysergic acid diethylamide

m meters

MASH mobile army surgical hospital

M20E1 simplified collective protection shelter system

M8/M9 chemical detector paper

M51 collective protection shelter system

MES medical equipment set

Mg milligram

mg/kg milligrams per kilogram

MILVAN military-owned remountable container

min minute

ml milliliter

mm millimeter

MOPP mission-oriented protective posture

MOS military occupational specialty

MRE meal ready-to-eat

m/sec meters per second

MT megaton

MTF medical treatment facility

MV (m = mass, v = velocity)

NaCl sodium chloride (salt)

NATO North Atlantic Treaty Organization

NBC nuclear, biological, and chemical

NBCC nuclear, biological, and chemical center

NBCWARN nuclear, biological, and chemical warning

NBCWRS nuclear, biological, and chemical warning and reporting system

NCO noncommissioned officer

O_2 oxygen

OEG operational exposure guide

OPLAN operation plan

OPSEC operations security

PA physician assistant

pmm preventive medicine measures

ppm parts per million

PPW patient protective wrap

PS chloropicrin

PT physical training

PVF polyvinyl fluoride

PVNTMED preventive medicine

QSTAG Quadripartite Standardization Agreement

RES radiation exposure status

RTD return to duty

S2/G2 Intelligence Officer (US. Army)/Assistant Chief of Staff, G2 (Intelligence)

S2/S3 Intelligence Officer (U.S. Army)/Operations and Training Officer (U.S. Army)

S4 Supply Officer (U.S. Army)

SOF Special Operations Forces

SOP standing operating procedure

sol solution

SSN social security number

STANAG Standardization Agreement

STAT statim

STB supertropical bleach

STRIKWARN strike warnings

TC training circular

TEMPER tent, expandable, modular, personnel

TM technical manual

tm trademark

TOE table of organization and equipment

TO theater of operations

trmt treatment

TSOP tactical standing operating procedures

µ microns

US United States

US/NATO United States/North Atlantic Treaty Organization

UN United Nations

VX a persistent nerve agent

WBGT wet bulb globe temperature

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By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
03818

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