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Public Health Journeyman

Volume 5. Contingency Operations

Air Force Institute for Advanced Distributed Learning
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Author: TSgt Robb T. Gudgel
USAF School of Aerospace Medicine
AFMC
Brooks Air Force Base, Texas 78235–5252
DSN 240-3731

Instructional Systems Specialist: Ann Duncan
596-1432

Editor: Nelva J. Brown

Air Force Institute for Advanced Distributed Learning
Air University (AETC)
Maxwell Air Force Base, Gunter Annex, Alabama 36118–5643

Material in this volume is reviewed annually for technical accuracy, adequacy, and currency. For SKT purposes the examinee should check the *Weighted Airman Promotion System Catalog* to determine the correct references to study.

THIS volume covers public health contingency operations (medical readiness). Unit 1 is an introduction to contingency operations and covers some of the historical impacts of contingency operations of the Air Force mission. The overall role of public health in contingency operations is explained.

Unit 2 focuses on field sanitation and addressing public health threats in a field environment (e.g., ensuring safe food and water, prevention of disease, increasing productivity in various climatic conditions, and methods of handling garbage and waste in field environments).

Public health responsibilities in nuclear, biological, and chemical environments are covered in unit 3. The unit begins with a discussion on various nuclear, biological and chemical (NBC) agents, moving through detection equipment to personal protection under NBC conditions. The last section in this unit deals with NBC decontamination as it applies to personnel, equipment, and food supplies after an NBC attack.

A glossary of abbreviations and acronyms used in this course is included at the end of this volume.

Appendixes A, B, and C are also included at the end of this volume.

Code numbers appearing on figures are for preparing agency identification only.

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To get an *immediate response* to your questions concerning subject matter in this course, call the author at DSN 240-3731 between 0700 and 1600 (CT), Monday through Friday. Otherwise, write the author at USAFSAM/AET, ATTN: TSgt Robb Gudgel, 2602 West Gate Road, Brooks AFB TX 78235–5252, to point out technical errors you find in the text, unit review exercises, or course examination. Sending subject matter questions to the Air Force Institute for Advanced Distributed Learning (ECI) slows the response time.

NOTE: Do not use the Suggestion Program to submit corrections for printing or typographical errors.

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This volume is valued at 15 hours (5 points).

Acknowledgment

PREPARATION of this volume was aided through the generous cooperation and support of TSgt Wes W. Walker and SSgt Mark St. Marie, both of the Force Health Protection team at USAFSAM. They provided technical guidance and information for all units within this volume.

Unit 2 was revised using DOD guidance suggested by the Armed Forces Medical Intelligence Center (AFMIC); Medical Environmental Disease Intelligence Countermeasures (MEDIC); NAVMED P-5010, *Manual of Naval Preventive Medicine, Preventive Medicine for Ground Forces*; and FM 21-10-1, *Unit Field Sanitation Team Training Manual*. Other guidance suggested may differ slightly; however, the intent (to prevent DNBI) is the same.

NOTE:

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then do the unit review exercises.

Page

Please read the unit menu for unit 1 and begin. ➔

Unit 1. Introduction to Contingency Operations

THIS volume explains our very important role in contingency operations. The first unit is an introduction to contingency operations. It will cover historical lessons learned and explain how planning helps prevent past problems from recurring. The planning process is described by explaining the overall duties of the public health team and the medical intelligence officer. The duties are not all inclusive; however, they will assist you in developing ways of preventing diseases in many readiness situations.

1–1. Contingency Operations History

Throughout past wars, there have been more personnel unable to perform their duties because of illnesses than from combat injuries. This was due to overcrowding, poor camp hygiene, inadequate medical support, and the physical stresses of combat. Many people, when they think of war, picture many wounded casualties from the fighting. The thought of massive numbers of troops unable to fight because of disease probably does not cross many minds. Most sickness in prior wars could have been avoided if people had been educated on the principles of disease prevention. As the scope and mission of the Air Force changes, we're finding ourselves involved in more peacekeeping functions and operations other than war. These operations are now referred to as military operations other than war (MOOTW).

This is where we fit in the picture. We need to educate people on how to prevent illness from draining our fighting strength. Of course, before you can educate others, you must educate yourself. First, you need to know how we developed some of our principles and see the importance of emphasizing compliance with these preventive medicine principles.

801. Public health lessons

We have learned to improve medical readiness from many historical events. We'll study just a few. When you read these segments, try to think of how the situation could have been prevented.

Guadalcanal

In 1942, American forces took almost five months to gain control of Guadalcanal. During this time, there were almost 60,000 cases of malaria reported. Personnel, equaling in numbers to the size of an entire division, were unable to fight in combat. This disease might have been prevented by protecting people from mosquitoes.

Japan

Another famous example was when Merrill’s Marauders were fighting the Japanese in 1944. Merrill’s Marauders started with 2,750 men. By the eighth day of the campaign to roadblock the Japanese, they had lost 45 men to combat injuries and 136 men to disease—primarily malaria and dysentery. This trend continued for 58 days. A total of 262 men were lost to combat-related injuries and 438 were disabled or killed by disease during these first 58 days. This unit did continue to damage the enemy until about 90 days into the campaign. The rate of disease had grown to affect 100 people per day. There were 424 combat-related injuries, while disease-related casualties reached 1,898 people. The unit had to be disbanded due to the high rate of disease.

North African desert

In the North African desert where the Allies were fighting German General Rommel, there was a good example of not learning from others’ mistakes. At one location the Germans had a sanitation problem with exposed feces and garbage. The sanitation problem led to a large increase in the fly population. The German unit moved out for rest and supplies. British and American troops moved into the abandoned site. The large fly population, along with poor sanitation, resulted in at least 1,000 British and American soldiers ending up sick with dysentery. The British and American troops had not taken the fly problem seriously, forcing the unit to withdraw because of the high rate of illness. Another unit was eager to replace them, but they also had to withdraw due to illness.

Sicily

Shortly after the desert incident, our forces were to land on the shores of Sicily. When the 7th Army was being assembled for the invasion, the leaders had to leave about 4,000 people behind because of malaria. About 700 more contracted malaria on the ships while being transported to Sicily. This disease outbreak kept a total of 5,000 people from seeing action. After the 7th Army arrived in Sicily and began marching through villages, they found another big problem, sand flies. Approximately 8,500 cases of sand fly fever were treated.

Vietnam

During the Vietnam conflict, approximately 10,000 people per year were treated by our medical units for malaria and dengue fever. Almost all of the personnel affected with malaria, dengue fever, and sand fly fever could have been protected and these cases probably prevented.

Now, you probably can see the importance of educating personnel to prevent a repeat of these tragic events. Prevention of communicable diseases is not the only area where we have learned to prevent casualties.

802. Operations other than war

The Cold War created an artificial world stability that disappeared with the breakup of the Soviet Union. The loss of this world power resulted in a dramatic increase in ethnic and political tensions throughout the world, which was often manifested by open hostility, bloodshed, famines, and refugee situations. In order to cope with these situations, many peace operations were launched, some under the auspices of the United Nations and others as unilateral actions.

MOOTWs are military actions conducted which are not associated with sustained, large-scale combat operations. MOOTWs typically involve:

- Peace building—post conflict rebuilding of governments.
- Peace enforcement—compel compliance with resolutions.
- Peacekeeping—monitor and facilitate implementation of agreements.
- Humanitarian relief operations.

Additionally, our forces may be called upon to respond to natural or man-made disasters anywhere in the world. These operations require us to change our way of doing business. Instead of solely providing preventive medicine support to our forces, we may be called upon to support the health and well being of indigenous populations. This will require us to understand the physical, medical, and preventive medicine needs of displaced refugee populations. Items of concern include nutritional needs, medical priorities, shelter, food, water, sanitation, disease prevention, and restoration of the public health infrastructure. We may work closely with nongovernmental organizations (NGO) or private volunteer organizations (PVO); which are private, nonprofit humanitarian assistance organizations involved in development and relief activities. They operate in most of the trouble spots around the world and should be looked to as a resource with vital experience. They also can provide valuable information on local customs, infrastructure, government, and situation assessments and can provide technical expertise such as disaster relief, development, feeding programs, agriculture, public health, water, nutrition, and sanitation. We must work with them as full partners for successful mission accomplishment. Recent operations have included Iraq, Bosnia, Haiti, Guantanamo Bay Cuba, Rwanda, and Somalia.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

801. Public health lessons

1. What disease caused 60,000 casualties in 1942 during the war campaign in Guadalcanal?

2. What two major diseases led to disbanding Merrill's Marauders?

3. What problem incapacitated the Allied and American units when they moved into an abandoned German war camp in the North African desert?

4. What were the causes for losing over 13,000 people during the invasion of Sicily before and after the attack?

802. Operations other than war

1. What are MOOTWs?

2. What are some of the conditions that lead to MOOTWs?

1–2. Deployment Planning

The medical service is responsible for planning and providing medical support necessary to sustain maximum combat capability and effectiveness under all conditions. All other medical service missions are secondary.

The problems inherent in accomplishing the medical mission are greatly increased by the complexities and destructiveness of modern warfare, natural disasters, and peacetime accidents. Consequently, plans are made in anticipation of war and disasters.

803. Deployment planning guidance

AFMAN 10-401, *Operation Plan and Concert Plan Development and Implementation*, provides guidance on Air Force unique planning aspects for all types of operations. This plan gives us a better understanding of how public health fits into the "big picture" of deployment planning. Air Force planning is accomplished in two ways—deliberate planning, and crisis action planning.

Deliberate planning is conducted principally in peacetime and is accomplished in prescribed cycles that complement other DOD planning cycles. One can only imagine the confusion that would be created if each military service were planning and executing procedures on its own. There will be times when advanced planning is impossible, and this is when crisis action planning takes place.

Guidance and procedures for each type of planning can be found in AFMAN 10-401. Deployment planning guidance is also received from the Joint Operation Planning and Execution System (JOPES), Time-Phased Force and Deployment Data (TPFDD), the USAF War and Mobilization Plan (WMP), unit type codes (UTC), and table of allowances (TA).

Joint Operation Planning and Execution System

JOPES is the DOD-directed, JCS-specified conventional command and control system for joint operation planning and execution. JOPES establishes the policy, procedures and system to be used in both deliberate and crisis action planning of joint operations.

Time-Phased Force and Deployment Data

The TPFDD file is a collection of information required during planning. This includes information on the combat and support units along with equipment and supply support information. The combatant commander's staff and the staff's service components develop a detailed transportation-feasible flow of resources into the theater to support the concept. The process consists of several discrete phases that may be conducted sequentially or concurrently.

USAF War and Mobilization Plan

The WMP is a classified document that provides the Air Staff and Air Force commanders current policies, planning factors, and forces for conducting and supporting wartime operations. It establishes requirements for developing mobilization and planning programs for industrial production to support sustained contingency operations of the programmed forces. It encompasses all basic functions necessary to match facilities, personnel, and materiel resources with planned wartime activity.

Unit type codes

A UTC is a five-character, alphanumeric code controlled by the JCS that uniquely identifies each type unit of the Armed Forces. The assignment of a UTC categorizes each type of organization into a class or kind of unit having common distinguishing characteristics. All Air Force UTCs approved for planning are found in the WMP. Each listed UTC contains the UTC's mission capability statement as well as deployment characteristics of the UTC in terms of personnel and cargo tonnage requiring transportation. For example, FFGLB is the code for a 2E mobile decontamination team, and FFGLA is used for patient decontamination equipment.

Allowance standards (AS)

An AS lists the logistical requirements necessary to support each UTC in accomplishing its mission. For example, AS 902 column A lists all equipment necessary for a decon team to be able to do their job.

804. Base Operations Plan (OPlan) 32-1

AFI 32-4001, *Disaster Preparedness Planning and Operations*, sets the requirements for each base to have a plan to cope with disasters in peace or war. The base's plan for disasters is called the Base OPlan 32-1.

Areas of concern

Some areas that must be addressed are described in the following table:

Area	Description
Situation	Describes the most probable condition for implementing the plan.
Primary Forces	Lists the specific tasks of friendly forces, commands, or other government agencies that directly support the plan.
Assumptions	Lists assumptions in the plan based on conditions likely to exist or that may have significant impact on mission operations.
Mission	States the basic task of and reason for using the plan.
Execution	States actions needed to carry out the plan.
Administration and Logistics	States how logistic support is accomplished.
Command and Communication	Describes installation warning and notification systems and capabilities. Identify command and control relationships among participants tasked to carry out the plan. Gives a general description of the scope and type of information systems for disaster operations.
Annexes	The annexes that a medical treatment facility will deal with most frequently are: Annex A, Major Peacetime Accident, which deals with our role in responding to peacetime accidents that occur on or off-base. Annex B, Natural Disaster, identifying our role in natural disaster response operations, including relief operations. Annex C, Enemy Attack, covering pre- and post-attack responsibilities, including shelter and contamination control procedures. Annex Z, Distribution, listing the required areas that must and should have copies of the Base OPlan.

Medical input

Medical planners use the format in AFI 32-4001 to prepare input for Base OPlan 32-1. The medical service provides technical medical information and advice on nuclear, biological, chemical (NBC) warfare, to include:

1. Information on physiological effects of NBC contamination.
2. Information on work/rest cycles for people in mission oriented protection posture (MOPP) 3 and 4 (AFMAN 32-4005).
3. Issuing and using chemical-biological warfare agent pretreatment drugs, prophylactic medication, and antidotes.
4. Providing medical intelligence (MI) estimates.

The responsibility for keeping the medical information in Base OPlan 32-1 current has been given to the medical readiness officer (MRO), medical readiness noncommissioned officer (MRNCO), or the medical readiness manager (MRM).

805. Medical unit plans

AFI 41-106, *Medical Readiness Planning and Training*, outlines our responsibilities for planning and providing support to meet mission requirements. It also provides us with references for developing plans.

In addition to providing input for the base plan, each US Air Force medical treatment facility must also prepare a Medical Contingency Response Plan (MCRP). These plans define medical operations in peacetime and wartime.

The MCRP establishes peacetime disaster response procedures and describes how medical unit personnel carry out those procedures. The MCRP must address real or perceived peacetime threats to the base and community such as natural disasters (e.g., tornadoes or hurricanes), major accidents (e.g., airplane crash), and terrorism. Each annex provides definitive information as to how, where, when, and who performs a particular function. Each annex is written by the chief of the specific team. For example, Annex E designates the public health team chief, gives the team composition, and provides guidance for actual functions the team performs during disaster situations.

The MCRP provides policy and local procedures to prepare for medical-specific operations in war. The plan fully describes how the medical unit will accomplish its wartime mission. Again, specific guidance for preparing the MCRP can be found in AFI 41-106. Annex E to the MCRP provides guidance for the public health team and designates a team chief. Usually the public health officer is responsible for preparing and maintaining Annex E of the MCRP. Planning for wartime medical support must be flexible and responsive. Your unit may be required to rapidly deploy to another country, and it may manage a large number of casualties resulting from a conflict. Therefore, the number of casualties expected and the effects of nuclear, biological, and chemical agents on the medical unit personnel and resources are major factors considered in the planning process for military medical operations.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

803. Deployment planning guidance

1. What system is DOD-directed?

2. When resources are planned to be sent to the theater of operations in a transportation-feasible flow, what is the collection of information called?

3. What is the WMP?

804. Base Operations Plan (OPlan) 32-1

1. What document defines areas that must be addressed when preparing input for the overall base operational plan?

2. What is a base's plan for disasters in both peace and war?

3. Who is responsible for keeping the medical information in Base OPlan 32-1 current?

805. Medical unit plans

1. Which document is a plan used to describe how a medical unit should operate during peacetime accidents, natural disasters, or medical operations during wartime?

2. What annex provides guidance for public health operations during wartime?

1–3. Medical Intelligence

Why do we have historians? Why do we bother to keep track of what has happened throughout history? We try to learn from our mistakes; however, this means our mistakes must be recorded. This is where the area of intelligence fits in. We will concentrate on the area of medical intelligence even though the other areas of intelligence will also help the medical mission.

806. Gathering medical intelligence

Medical intelligence is that category of intelligence concerned with factors affecting a person's capability and well being in a foreign environment.

Defining medical intelligence

MI is information about diseases, climatic conditions, and other health-related environmental factors. It also includes information about medical capabilities and research and development (R&D) activities of other countries. If our armed forces are called upon to fight in other parts of the world, prior knowledge of endemic diseases and health threats and their countermeasures can mean the difference between winning and losing the battle. Furthermore, knowledge of the abilities and interests of both our friends and foes can influence how effective our forces are in combat. Finally, MI may help our own R&D activities if we know what our adversaries and allies are working on. For example, if we know another country has developed a new chemical warfare agent, we may want to begin development of an antidote. Also, if a good product is marketed by another country, we can save tremendous R&D costs by acquiring the already developed product. If MI is to be effective as a preventive measure, this information must be used prior to a unit's deployment.

The overall goal of MI is to prevent degradation of the mission due to endemic diseases; environmental factors; and hazardous insects, plants, and animals. Since MI involves so many different areas, it is not surprising that we get MI from many different sources.

Sources of MI

Most MI is obtained directly from people. Smaller amounts are obtained from scientific journals and other literature or from analysis of foreign medical material. These sources include unclassified intelligence reports, geography books, encyclopedias, and other commonly available reference materials, as well as classified intelligence products.

The Armed Forces Medical Intelligence Center (AFMIC) is the joint military agency that collects medical information from other countries. All AF members should recognize their potential to gather MI when overseas and pass on any pertinent items to their local intelligence office. Additionally, trained observers are sent to areas of special interest to gather MI for future use. Finally, some MI is gathered by persons living and working in these foreign countries. Articles published in foreign scientific journals may give clues to other countries' research interests. By analyzing captured medical material (e.g., chemical warfare antidote kits) we can determine an adversary's medical capabilities and plans. The medical intelligence officer is responsible for compiling MI for the specific mission at each base.

Gathering MI

When gathering MI information, the key is to have a focused approach with the objective clearly in mind. Sounds a lot like writing a good letter, doesn't it?

First, start simple by using the resources that are readily available in your office, unit, or base library. Examples of good sources are other people, newspapers, magazines, encyclopedias, atlases, maps, travel agencies, and professional entomologists. As you begin gathering this preliminary data, you'll see your objective starting to take shape.

Second, talk to the professionals that are working within the Air Force and DOD who are trained to specialize in key aspects of MI. Some good sources are the Armed Forces Pest Management Board (AFPMB) and the Defense Pest Management Information Analysis Center (DPMIAC). In addition, some organizations publish several documents that have proven to be very helpful when gathering MI:

- The Disease Vector Ecology Profile (DVEP).
- Navy Preventive Medicine Information System (NPMIS).
- Technical information bulletins/manuals.
- Disease Risk Assessment Profiles (DISRAPS).
- Vector Risk Assessment Profiles (VECTRAPS).
- AFMIC Weekly Wire.
- AFMIC Disease Occurrence Worldwide (DOWW).
- AFMIC Disease Environmental Alert Reports (DEAR).
- MEDIC—now available on CD-ROM.

Third, use civilian sources such as the Centers for Disease Control, Morbidity, Mortality Weekly Report (MMWR), International Association for Medical Assistance to Travelers (IAMAT), and the World Health Organization.

Sounds like a lot of places to look, but don't panic. The more often you use these sources, the quicker you'll be able to locate the information that you need for MI briefings.

807. Medical intelligence officer

The medical treatment facility commander appoints a medical intelligence officer (MIO). AFI 41-106, *Medical Readiness Planning and Training*, states a pubic health officer should fill this position; however, in his or her absence, an NCO with appropriate experience or a 4E0X1 may be appointed.

The MIO will use many sources of information to assess the threat a unit faces and the capabilities they will require.

The MIO has many responsibilities. These are described in the following table:

When	Responsibility
Before deployments	Works with line intelligence to prepare the medical threat assessment and to ensure that medical risks are included in the final threat brief. Briefs the medical unit commander and deploying medical and line personnel on medical risks and unit individual countermeasures. Verifies predeployment medical screening and immunization requirements for deploying personnel are identified and completed.
Upon arrival at location	It is important for the MIO to assist the unit commander in selecting the site for facility setup. It is always easier to prevent problems than correct them after they occur.
During deployment	Incidences of disease, illnesses, injuries, or any other degradation of human performance must be recorded and analyzed. The MIO verifies and documents corrective actions taken, and informs the MTF commander of any new medical threats throughout the deployment. This way the medical threat to personnel can be communicated and corrective measures can be taken.
Following deployment	Compile after-action reports during the following situations: WRM supplies are used, personnel UTCs are deployed, involvement in higher headquarters or JCS exercises, national emergency, natural disaster, and armed conflict. Must complete a medical intelligence questionnaire prepared by AFMIC following the deployment. Summarize the medical intelligence questionnaire addressing areas such as terminal chemoprophylaxis, tuberculosis skin testing required, and follow-up actions. This way, a summary of the conditions encountered is documented and may be used in the future to prevent any reoccurrence. These after-action reports are due to the MAJCOM 30 days after return, and the MAJCOM will provide the response format. Additional copies are forwarded to the appropriate agencies listed in AFI 41-106.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

806. Gathering medical intelligence

1. Define medical intelligence.

2. What are the methods of collecting medical intelligence?

807. Medical intelligence officer

1. In the absence of an officer in the public health office, who may be appointed as the MIO?

2. At what times should an MIO either recommend measures or report findings when a unit is scheduled for a deployment?

Answers to Self-Test Questions

801

1. Malaria.
2. Malaria and dysentery.
3. Sanitation was so poor that fecal material and garbage caused a fly infestation so large that there were about 1,000 casualties with dysentery.
4. Malaria and sand fly fever.

802

1. Military actions conducted which are not associated with sustained, large-scale combat operations.
2. Peace building (post-conflict rebuilding of governments), peace enforcement (compel compliance with resolutions), peacekeeping (monitor and facilitate implementation of agreements) and humanitarian relief operations.

803

1. Joint Operation Planning and Execution System.
2. Time-Phased Force and Deployment Data.
3. The War and Mobilization Plan which provides commanders current policies, planning factors, and forces for conducting and supporting wartime operations.

804

1. AFI 32-4001, *Disaster Preparedness Planning and Operations.*
2. Base OPlan 32-1.
3. The medical planners—medical readiness officer, medical readiness noncommissioned officer, or the medical readiness manager (medical planners).

805

1. Medical Contingency Response Plan.
2. Annex E.

806

1. Information about diseases, climatic conditions, and other health-related environmental factors. It also includes information about medical capabilities and R&D activities of other countries.
2. Most intelligence is gathered from human sources; however, some is gathered from scientific journals and other literature or from analysis of foreign medical material. These sources include unclassified intelligence reports, geography books, encyclopedias, and other commonly available reference materials, as well as classified intelligence products.

807

1. A 4E0X1 or an NCO with appropriate experience.
2. Before deployments, upon arrival at a deployment location, during the deployment, and after a deployment.

Do the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI (AFIADL) Form 34, Field Scoring Answer Sheet.

Do not return your answer sheet to AFIADL.

1. (801) During World War II, why did two Allied units withdraw from positions previously occupied by Germans in the North African Desert?
   a. Dengue Fever infected the camp.
   b. Malaria infected one-half of the camp.
   c. Flies spread disease from the exposed feces.
   d. Heat stroke affected the leaders in the desert.

2. (802) Recent MOOTWs have been seen in Bosnia,
   a. Rwanda, Iraq, and Haiti.
   b. Rwanda, and Oklahoma City.
   c. Iraq, and Homestead, Florida.
   d. Iraq, Haiti, Somalia, and Japan.

3. (803) A collection of information used during the planning of resources to be sent to the theater of operations in a transportation-feasible flow is called
   a. JOPES.
   b. TPFDD.
   c. WMP.
   d. CSP.

4. (803) Which two ways is Air Force planning accomplished?
   a. Deliberate and noncrisis action planning.
   b. Deliberate and crisis action planning.
   c. Peacetime and contingency planning.
   d. Peacetime and wartime planning.

5. (804) Which document defines areas that must be addressed when preparing the overall base operational plan?
   a. The Base Oplan 32–1.
   b. The Disaster Casualty Control Plan.
   c. AFI 41–106, *Medical Readiness Planning and Training.*
   d. AFI 32–4001, *Disaster Preparedness Planning and Operations.*

6. (805) Which document is written to provide guidance for medical operations during wartime?
   a. Base OPlan 355–1.
   b. DCCP.
   c. MCRP.
   d. MRCR.

7. (805) Which CSP annex provides guidance for the public health team?
   a. F.
   b. G.
   c. E.
   d. P.

8. (806) MI is information about diseases,
   a. and climatic conditions.
   b. climatic conditions and gross national product.
   c. climatic conditions and other health-related environmental factors.
   d. climatic conditions, health-related environmental factors, and key government figures.

9. (806) How is most medical intelligence obtained?
   a. Espionage activities.
   b. Directly from people.
   c. Medical journals and newspapers.
   d. Hands-on experience and through the grapevine.

10. (806) When is the *most* important time medical intelligence is used as a preventive measure?
   a. Upon appointment of a MIO.
   b. Prior to a unit's deployment.
   c. After a unit returns from a deployment.
   d. During training sessions with medical personnel.

11. (807) Who appoints the base medical intelligence officer?
   a. Base commander.
   b. Chief, public health.
   c. Medical treatment facility commander.
   d. Commander, aerospace medicine council.

12. (807) In the absence of the public health officer, who is normally appointed as the medical intelligence officer?
   a. Senior 4E0X1.
   b. Senior 4M0X1.
   c. Medical supply officer.
   d. Infection control officer.

Please read the unit menu for unit 2 and continue ➔

Student Notes

Unit 2. Field Sanitation

PUBLIC health strives to prevent disease and nonbattle injuries (DNBI). As you learned in unit 1, DNBI has severely taken its toll on troops throughout history. In fact, DNBI has historically accounted for approximately 80 percent of hospital admissions during wartime compared to only 20 percent from battle injuries. We can significantly reduce the amount of DNBI in contingency operations by preparing, equipping, and educating deploying personnel. Personnel must be given a predeployment qualification review that includes medical and immunizations records review. Personnel must be medically fit to deploy; otherwise, they may jeopardize the mission if there is a loss of manpower due to illness. All personnel should be up-to-date on mobility immunizations as required by AFJI 48-110, *Immunizations and Chemoprophylaxis*. If personnel are immunized, they are provided protection against disease. We must use the knowledge we've gained through previous experiences and put it to work when we are living under field conditions. This unit focuses on disease prevention under field conditions—safe food and water, controlling wastes properly, and protecting personnel from environmental injuries. Remember that there are no clear-cut answers to problems we encounter in the field, but we can reduce DNBI if people are trained and educated in disease prevention.

2–1. Preventive Medicine in Field Conditions

DNBI causes the greatest loss of manpower through disability and time lost from duty. If we are to accomplish our objectives, personnel must be in a constant state of readiness. To maintain this desired state of readiness in a field situation, proper sanitation and hygiene are essential. You will have the opportunity to take everything you've learned, adapt it, and use it in field situations to help maintain the health and welfare of unit personnel.

808. Public health threats under field conditions

In previous volumes you have learned how diseases spread and how they affect humans. You know diseases can be transmitted from person to person or from animals to people through direct contact, inhalation or airborne droplets, contaminated food or water, and vectors. The information provided in the next few lessons will prepare you to better identify public health concerns for Air Force personnel deploying throughout the world.

Disease types and countermeasures

There are many types of diseases that our personnel may encounter in the field. It is our job, through medical intelligence information gathering, to educate deploying forces on methods of preventing them from becoming victim to diseases throughout the world. Disease statistics show there are four types of diseases that occur frequently in contingency operations:

1. Diarrheal.
2. Upper respiratory illness (URI).
3. Skin.
4. Vectorborne.

In addition to these diseases, there are many other factors we must consider that may adversely impact the effectiveness of our forces in the field.

Diarrheal disease

There is nothing worse than living in field conditions and having a bad case of diarrhea. Travelers' diarrhea, giardia, shigella, and typhoid are all examples of diarrheal diseases that can occur during contingency operations. Public health's responsibility is to educate deployed personnel prior to, and during a deployment on the types diarrheal diseases they may encounter and what they can do to prevent themselves from becoming affected. Diarrheal diseases are introduced as a result of a breakdown in personal hygiene, sanitation, food preparation, or water treatment. Food or water becomes contaminated by direct contact with the infectious agent or by contact with a mechanical vector such as flies, rodents, etc. Good personal hygiene and proper handwashing cannot be overemphasized. Good sanitation, ensuring that immunizations are kept up to date, and using only approved sources of food and water will reduce your chances of getting a diarrheal disease.

Upper respiratory illness

Diseases of the respiratory tract are caused by direct contact or inhalation of infectious microorganisms that are carried on airborne droplets or dust particles. Respiratory infections (e.g., influenza, colds, sore throats, tuberculosis, and meningococcal disease) can be highly contagious, particularly in crowded conditions. Additionally, tuberculosis infections are increasing rapidly in many areas of the world, and can be a significant threat to personnel in close contact with indigenous populations. These bacteria and viruses may also be indirectly transmitted through ingestion by the use of common cups, food utensils, cigarettes, etc. Countermeasures to prevent respiratory diseases in the field consist of immunizations, living areas with adequate space and ventilation, head-to-foot sleeping arrangements, and frequent handwashing to reduce droplet and aerosol spread of respiratory diseases. Also, remind deploying personnel to always cover their mouths if they cough or sneeze, and to immediately wash their hands so they will not pass the germs to someone else.

Skin disease

Breakdowns in basic personal hygiene and sanitation are the number one causes of skin disease in the field. Situations that cause us to deploy can often send our troops into a harsh environment with minimal amounts of safe bathing water. If only small amounts of water are available, deployed personnel cannot maintain good personal hygiene. Good personal hygiene is important in preventing skin diseases such as fungus, dermatitis, and even parasites. Good personal hygiene is the most important countermeasure against skin disease; therefore, personnel must plan to make provisions for bathing. If a daily shower is not available, personnel should be encouraged to clean (dip bathe) the five areas (5 Fs) most important to ensure good personal hygiene—face, fingers, feet, fanny, and front. While deployed, our personnel should be encouraged to limit the use of cologne or perfumes since they contain alcohol, which opens pores, inviting infection and the attraction of insects.

Vectorborne disease

You may be deployed to exotic locations (e.g., Rwanda, Panama, or even Colombia). What do all of these locations have in common? Vectors and the potential for vectorborne disease. Our deployed personnel run the risk of being exposed to a variety of exotic arthropods and arachnids all over the world. We must educate our personnel and provide them with the tools necessary to protect themselves against vectorborne diseases. Immunizations, chemoprophylaxis, avoidance, personal hygiene, and personal protection are all countermeasures we can take in the field to prevent vectorborne diseases. We will discuss these countermeasures in detail in lesson 809. It is up to us to ensure all units practice these countermeasures in order to reduce the incidence of vectorborne disease in the field.

Other public health threats and countermeasures

Like the diseases mentioned above, there are many other public health threats that may adversely affect Air Force personnel throughout the world. Some of the other threats are hazardous flora (plants) and hazardous fauna (animals) and the environmental conditions.

Hazardous flora and fauna

Each part of the world has its own indigenous fauna and flora. Many of these can cause serious injury or illness to our personnel. Some examples of these are rattlesnakes, cobras, bushmasters, scorpions, centipedes, black widows, poison sumac, and manchineel trees. Hazardous flora and fauna are especially dangerous when personnel are deployed to areas where they are not familiar with the indigenous species. For example:

- A person from the United States that enjoys seashell collecting in the shallows of our shoreline could receive a life-threatening sting from a Geographer Cone shell, *Conus geographus*, when in the south Pacific or Indian oceans.
- While waiting for aircraft in Somalia, US armed forces personnel found a “green snake” behind the PAX terminal. One member decided to pick up the snake since it looked like the nonvenomous, green garden snake here in the United States. Fortunately, one of our public health officers was there to educate the person about the Green Mamba, *Dendraspis angusticeps,* being handled. Green Mambas may look like a garden snake; however, they are one of the most dangerous snakes. The Green Mamba is very aggressive and carries a highly potent neurotoxin in its venom.

In most cases, the indigenous fauna have no desire to be anywhere near humans; however, when inadvertently trapped or when they feel threatened, they will defend themselves. The usual exposure occurs when the cold-blooded creature (e.g., snake or scorpion) is looking for a warm place (e.g., your boot or bedding), and upon meeting, casualty can occur.

Other often-overlooked threats in the field are bees and wasps. Bees and wasps kill more Americans each year than all snake, spider, scorpion, and centipede bites combined. The primary reason is anaphylactic shock, which occurs when an individual has a hypersensitivity to stings. Hypersensitivity may be hereditary or acquired, and it can range from local swelling to systemic swelling, which can constrict breathing and rapidly stop the heart. Personnel susceptible to anaphylactic shock should be identified prior to deployment and issued (by a doctor’s prescription) epinephrine (epi) kits. The latest epi kit is the Epi Pen, which is easy to use and may save the individual’s life if stung far away from medical care.

It’s up to you, as a public health journeyman, to protect personnel from becoming a liability for the operation by educating them about the dangerous indigenous species found around the world. Your recommendations and suggested countermeasures should stress prevention and avoidance unless personnel are specially trained to handle such exotic plants and animals.

It is not possible to educate personnel on all species in an area of operation. Your educational efforts should focus on the major threats. The keys to working in areas with hazardous flora and fauna are recognition, avoidance, and antivenins.

Recognition

Before we can make a recommendation on what to avoid or how to prevent injury, we must research and be able to recognize the hazardous species indigenous to the area of operation.

There are numerous species dangerous to man in the world, and there are numerous sources of information to research. The following table lists some sources you should use when doing your research on hazardous flora and fauna in preparation for a deployment (this is not an all-inclusive list):

Suggested Reference	Contents
4E051 CDC, Vol. 2, *Disease Recognition and Control.*	Discusses basic fundamentals of disease recognition and control specifically the medical entomology unit.
Medical Environmental Disease Intelligence Countermeasures (MEDIC) CD-ROM; an AFMIC production.	Contains many of the publications used to give recommendations for field sanitation and hygiene, and predeployment information. Also contains country profiles, and a section with color pictures and scientific names of some of the hazardous flora and fauna throughout the world.
Venomous Snakes of the Middle East (DST-1810s-469-91); an AFMIC publication.	Color pictures of the snakes found in the Middle East with descriptions and detailed information on each snake.
Poisonous Snakes of Europe (DST-1810S-167-86); an AFMIC publication.	Similar to the *Snakes of the Middle East*, only it covers the snakes found in Europe.
AFP 64-4, Vol. 1, *Survival Training.*	A survival-training guide that outlines survival in various climactic conditions, and includes countermeasures for field-related threats.
FM 21-76, *Survival.*	An all-encompassing survival handbook designed to be carried during deployments. Gives color pictures of hazardous flora and fauna and "how to" information for survival tips in various conditions.
U.S. Army Environmental Hygiene Agency (USEHA*), Guide to Poisonous and Toxic Plants* (TG # 196).	Provides pictures and detailed information on poisonous and toxic plants.
NAVMED 5099, *Poisonous Snakes of the World*, ISBN# 0-486-26629-X.	A comprehensive guide to the poisonous snakes of the world.

Avoidance

The basics for avoiding snakes, arthropods, and plants in your area of responsibility (AOR) are:

- Mowing back vegetation around the deployed location so that contact is minimized.
- Wear gloves when reaching under things if you cannot see what's under them while in the field.
- When you take your boots off at night, cover them by rolling socks over the tops, or keep them inside your bed-net.
- Shake out your bedding before getting in to scare away any unwanted visitors.
- Shake out your clothing before putting it on.
- Roll down sleeves and flip up collars before entering brush to maximize your protection.
- Apply and use the personal protective equipment that you learned about in your entomology block.

Antivenins

Another public health concern in deployment planning is “antivenins.” Work with pharmacy personnel to ensure they know what types of hazardous flora and fauna are indigenous to your area of deployment, and what antivenins are available. Research for available antivenins begins in AFMIC’s MEDIC. Another excellent source of antivenins worldwide is the “Antivenins Around the World” site available on the Internet through the public health home page under our Entomology page. By educating personnel about the indigenous threats around the world you may be able to prevent serious injury and in some cases prevent death.

Environmental injuries

To perform effectively in any climate, personnel must first become acclimatized to the new climate. Troops living and working in extreme temperatures must recognize the hazards associated with heat and cold. Our personnel must know what measures to take to prevent thermal stress problems. For cold temperatures, individuals should wear extra clothes in loose fitting layers. In the heat, personnel should recognize the need for water consumption to prevent heat injury. High altitude is another environmental element that can cause injuries (e.g., high altitude pulmonary edema). Commanders and their troops must be educated on acclimatization and prevention of environmental injury. Heat and cold injuries will be discussed in detail in section 2–4 of this volume.

Personal hygiene

Personnel can reduce their chances of getting a disease by practicing good personal hygiene. When in the field, scrupulous personal hygiene is a must. Diarrheal, upper respiratory, skin, and vectorborne diseases can result from one common problem—poor personal hygiene. One of the most important countermeasures in the field is good personal hygiene. Good personal hygiene is accomplished through proper handwashing, practicing good oral hygiene, showering, and foot care. By keeping your hands, skin, hair and clothing clean, you are preventing an invasion of bacteria, fungus, and even parasites.

Handwashing

Personal hygiene, especially handwashing, is critical in preventing the spread of disease during field operations. Handwashing after visiting the latrine must become an unfailing habit. Your job is to educate all deploying personnel on the importance of handwashing in the field. We need to ensure that handwashing stations are available for the site population. Figure 2–1 illustrates an example of one type of handwashing device. Handwashing facilities and latrines may be primitive or nonexistent, and water may be scarce and/or contaminated. All of these things must be taken into consideration if diseases are going to be controlled in the field. At a minimum, handwashing stations must be located near latrines, at the entrances of food, and in medical treatment facilities. Handwashing cannot be overemphasized in the field to prevent the spread of disease.

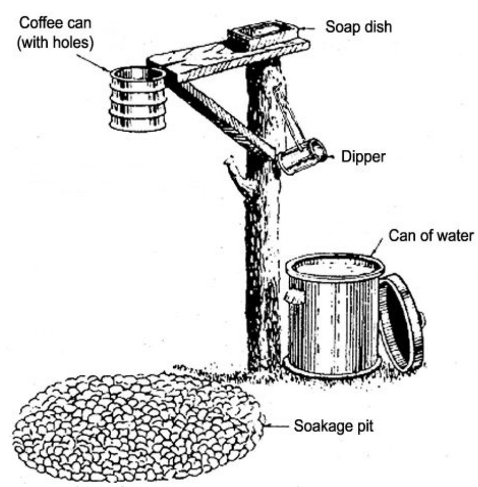


Figure 2–1. Handwashing devices.

Showering

Filth and disease go hand-in-hand. Unwashed skin can be an open invitation for infection or fungus. Dirty clothing worn for a prolonged period of time and unwashed hair are open invitations to body or head lice. Personal hygiene in the field should be strictly enforced and promoted by providing shower/bathing facilities to reduce the daily spread of disease. Deployed personnel must bathe at least once a week while in the field and frequently change to clean clothing to reduce the health hazard associated with body lice. Shower shoes should be encouraged to prevent foot fungus. All shower facilities must have a soakage pit underneath them to prevent water from collecting and forming pools. Camp work details should be formed and instructed to clean and disinfect latrines and showers with 100-ppm chlorine on a daily basis. Shower facilities should be evaluated on a routine basis for cleanliness and insect infestation. Experience in Desert Storm shows field showers provide an optimum environment for insect breeding due to the accumulation of moisture, dead skin, and hair. If this occurs, the facility should be disassembled, thoroughly cleaned, and treated for infestation.

Foot care

Dirty, sweaty socks may cause the feet to be more susceptible to disease. In boots, your feet are more prone to sweating than other parts of the body. Moisture in the socks will reduce their insulating quality and can lead to foot problems. Feet should be massaged daily, toenails trimmed (not too short), and blisters cleaned and protected. Moleskin (a padded bandage) is an excellent way to keep reddened areas on feet from becoming blisters. Foot care must be given extra attention during field operations. Deploying personnel should be encouraged to:

- Bring at least the minimum number of boot socks required by current mobility guidance.
- Keep socks clean and dry.
- Change wet or damp socks as soon as possible.
- Wash feet daily, if possible, and allow them to dry thoroughly before putting socks and boots back on.
- Avoid tight socks and boots, as they limit air circulation and evaporation of sweat.
- Use antiperspirants containing aluminum chlorhydrate or foot powder to help control the sweating of feet.

809. Public health responsibilities during contingency operations

There are many different situations that require using good field sanitation practices (e.g., field exercises, shelter exercises, mobility deployments, operations other than war, and/or actual warfare). In each situation, it is extremely important for us to educate personnel about conditions and practices conducive to good health and personal hygiene. Without education, many more patients will be seen at the medical treatment facility. To be effective, public health must be part of the planning process and site selection process when setting up a “bare base.” Our responsibilities may vary from deployment to deployment; but as a minimum, public health must be included in:

- Site selection.
- Development of the overall site setup.
- Continuing training for deployed personnel to ensure public health threats are minimized.

Through effective planning, our forces can rapidly deploy to bases and be capable of supporting and launching sustained combat operations with the same independence as we’re accustomed to in fixed facilities.

Site selection

As the Air Force downsizes and our operations tempo increases, we find more and more personnel on deployment to remote locations. Sometimes all there is to begin the operation is a landing strip that must be transformed into an operational base. This is the premise of the “bare base” concept. With today’s mobility concepts, there are hundreds of potential bare bases in foreign nations that possess runways, taxiways, and air terminal facilities that could be used by our forces during contingencies. As a public health journeyman, you must be involved in the planning process to select a site that will sustain good health and evade disease. If not included in the planning process, you or your OIC/NCOIC should request to be included. Failure to plan is planning to fail.

You should select a site that is relatively free of vector breeding areas, has a good water source, has proper drainage, and will facilitate breaking the chain of infection for disease. Information gathering at this point becomes critical. Most of your information gathering will occur during your medical intelligence research, which you learned earlier in this volume. Your involvement in the site selection process is your best chance to apply all of the skills and knowledge of public health. You can apply all of the knowledge that you have gained from your medical intelligence gathering to increase the effectiveness of the troops in support of the overall mission. Areas to consider in site selection include:

- Topography/climate data.
- Water sources.
- Vectors.

Topography/climate data

Topography and climatic conditions should reveal prevailing wind direction and expected velocity, temperature extremes, annual rainfall, humidity, natural slope of the terrain, soil characteristics, and latitude and longitude of the site. Some questions you may want to answer are listed below.

Question	Information to Consider
What season of the year is it (e.g., rainy, typhoon)?	If you are deployed during the winter months and plan to stay through spring, will your site still be frozen or will you end up in the middle of a marsh or swamp?
What are the average temperature ranges throughout the projected length of the deployment?	Knowing the temperature extremes that you may be exposed to will help you make better decisions about the kinds of items to bring. This information is also helpful to properly site sewage lagoons and decontamination sites downwind, determine air-conditioning or heating requirements, set up facilities away from natural drainage or flooding areas, and to determine absorption rate of soils for liquid waste. If soils are rocky, frozen, or a high water table exists, then personnel must plan to burn wastes instead of bury.

Water sources

Selection of a water source is one the most important elements of the site selection process. Water source selection is accomplished by a team that includes civil engineering (CE) (water production and environmental), security police, and preventive medicine personnel. Civil engineering is the POC. Water may be obtained from a variety of sources in the field such as rivers, streams, ponds, lakes, wells, existing water distribution systems, and bottled water. When choosing a water source, the following factors must be considered:

- Quantity—Will the source provide an adequate supply of water for all personnel for the expected duration of operations?
- Quality—Is the water free of contamination such as sewage, toxic chemicals, and/or NBC agents?
- Accessibility—Is the sourced accessible to water purification and transport equipment?
- Vulnerability—Can the source be made secure against contamination by sabotage or enemy attack?

In field conditions, personnel must have enough safe water for drinking and for personal hygiene. The quantity of water required for personnel varies with the season of the year, the geographical area, and the tactical situation. The table below provides water use planning factors for determining potable and non-potable water consumption needs.

Water Use Planning Factors (AFPAM 10-219 Vol. 5)

FUNCTION	USAGE FACTORS (gal/person/day)
Potable Water	
Drinking	4.0
Personal Hygiene	2.7
Shower	1.3
Food Preparation	3.0
Hospital	1.0
Heat Treatment	1.0
Nonpotable Water	
Laundry	2.0
Construction	1.0
Graves registration	0.2
Vehicle Operations	0.3
Aircraft Operations	2.0
10% Loss Factor	(1.5)
TOTAL	20.0

Vectors

You learned about vector breeding areas in volume 2. Everything you learned will now be put to use when choosing a deployment site. Be aware of swamps, drainage ditches, old tire dumps, and other artificial containers that may be an ideal breeding ground for hazardous vectors. Choose a site away from vectors, especially if your medical intelligence reveals vectorborne disease in your AOR.

Site setup

The way facilities are set up can significantly impact the effects DNBI has on the deployed personnel. To avoid vector or mechanical transmission of disease, you must separate the waste areas from eating and living areas. Commanders often want an exact distance for locating the latrines from food operations to prevent the spread of diseases. However, there are no magic numbers to prevent cross contamination. Good sanitation and hygiene must be continually reinforced to become a learned attitude. Numbers cannot make command decisions, only commanders can. In most deployment situations, we will be giving our recommendations through the medical commander to the base commander so he or she can make sound command decisions. Our recommendations may or may not be followed, but it’s our job to ensure that the commander is informed to prevent DNBI from impacting the mission.

Facility placement

The following table is not all-inclusive. Common sense must be used to ensure areas that may be ideal breeding areas for flies, rodents, or mosquitoes are located away from areas where personnel eat, work, rest, and play.

Reference	What and How Far?	Why?
FM 21-10, *Field Hygiene and Sanitation*	Food facilities must have a grease separator between food facility and soakage pit: 100 yards (yd) uphill, upwind, upstream from latrines, and 30 yd from garbage and soakage pits	To prevent contamination of water supply used for cleaning, to prevent the attraction of rodents and insects, and to avoid the smell from other facilities to reach food serving and eating areas.
FM 21-10-1, *Unit Field Sanitation Team Training Manual*	Latrines: 100 yd downhill, downwind, and down stream from food facilities and 100 feet (ft) from nearest water source, and at least 50 ft from sleeping quarters.	To avoid contamination of water and food sources. Also, far enough from sleeping quarters to prevent odors to travel to living areas, yet far enough away to prevent troops from using areas around their living quarters to urinate or defecate.
NAVMED P5010, *Manual of Naval Preventive Medicine, Preventive Medicine for Ground Forces*	Garbage and soakage pits: 30 yd from food facilities, a minimum of 50 ft from latrines, and away from flightline noise.	To eliminate rodents and insects from being attracted to food facilities and to prevent odors from traveling to food facilities.
	Water points: Upstream from all waste sites. Storage tanks must be located at least 50 ft from sewage disposal system.	To prevent cross contamination.
	Hospital: Away from tactical targets.	To be able to provide care during wartime.
	Patient decontamination site: 250 ft downhill, downwind, and downstream from the hospital. At an accessible location to intercept patient flow.	To provide a smooth transfer of contaminated patients without contaminating the medical treatment facility (MTF).
	Contaminated materials dump: 75 ft downhill, downwind, and downstream from the decon site.	To avoid cross contamination or recontamination from removed materials.

Preventing disease transmission in the field

Proper waste disposal

Under field conditions, large quantities of all types of waste—liquid and solid—are generated at approximately 100 pounds (lb) per person, per day. These materials must be removed and disposed of promptly; otherwise, the camp will quickly become an ideal breeding area for flies, rats, and other vermin. Filth-borne diseases such as dysentery, typhoid, and plague could become prevalent. Try to imagine a camp with no waste disposal facilities. Besides the health threat, the flies, the smell of human waste, and the sight of garbage piling up, would certainly decrease a unit's morale. You will learn ways to dispose of waste in a field situation so that it does not present a problem later. Public health personnel are responsible for inspecting waste disposal facilities and operations, as well as recommending changes that are necessary to protect the health and welfare of personnel.

Safe food and water

Safe food and water in sufficient quantities is essential to any unit's existence. Even the most appetizing food can cause illness if it becomes contaminated with disease germs. Outbreaks of food poisoning have resulted from improper handling of foods. We must ensure food is safely prepared, served, and stored if we are to prevent foodborne disease outbreaks. We must educate personnel to consume food and water from approved sources only. On deployments, the two most commonly used and easily approved food sources are meals-ready-to-eat (MRE) and dining facilities which may use tray pack rations (T-Rats). Personnel may get bored eating at the same food establishment every day, and those tantalizing foods offered by street vendors outside the gate begin to look tempting. We must make sure our troops are educated on the risks of consuming food from unapproved sources. However, sometimes we may find ourselves away from approved sources and forced to eat food and water off the economy. Some simple rules to prevent foodborne disease outbreaks are:

- Eat only foods served to you piping hot.
- Avoid dairy products; some countries do not pasteurize their dairy products.
- Eat only fruits and vegetables that can be peeled, by peeling you can remove any contamination.
- Do not eat food from streetside vendors.
- Drink only bottled water or carbonated beverages from approved sources. Do not drink local water or consume ice.

If you cannot determine where these vendors have purchased the food or how they have prepared or handled it, your chances of acquiring a foodborne disease are increased. We will cover food and water in depth in section 2–2.

Disease surveillance

Once you have set up your site and provided safe food, water, and waste disposal, disease surveillance should be the next step in preventing disease. Disease surveillance is necessary to determine if you have any "broken field sanitation and hygiene links" at the deployment location that could cause disease. For an example, troops going into the local community and purchasing food from a questionable street vendor causes an increase in the number of cases of diarrhea. An epidemiological investigation would need to be initiated to determine source of high numbers and countermeasures. A countermeasure for this type of behavior would be reeducation of the troops.

The Joint Staff Weekly Medical Surveillance Report form should be used to track diseases occurring at your location. Disease case numbers are gathered from your MTF, or squadron medical elements. Diseases should be recorded daily and sent through the preventive medicine chain of command at the unified command level. Not only does this let you know what is occurring in your deployed population, it is also gathering disease surveillance for the overall "big picture" of the deployment. The medical commander should also be briefed on disease surveillance results by public health weekly. If your surveillance data indicates a problem or outbreak, the medical commander should be updated more frequently.

Vectorborne disease prevention

"Integrated disease management" is the combination of immunizations, chemoprophylaxis, personal protection, and avoidance to further protect oneself from arthropods and arthropod-borne disease. Individuals can practice countermeasures to reduce their chances of getting vectorborne diseases while living in field conditions. Preventing vectorborne diseases can be easy if personnel adhere to the preventive medicine countermeasures listed below.

Immunizations

Immunizations for yellow fever, plague, and Japanese encephalitis are among the first line of defense for our troops to remain protected from vectorborne disease.

Chemoprophylaxis

Medications like mefloquine, doxycycline, primaquine, and chloraquine are frequently prescribed to prevent Air Force personnel from becoming a victim to malaria. Medications are ingested before exposure to vectorborne disease. They circulate in the body killing disease pathogens. Some pathogens are resistant to chemoprophylactic treatments and may require alternative solutions to prevent disease. Chemoprophylaxis doesn't change the immune system, so sometimes it is required before, during, and after a deployment to ensure its effectiveness.

Personal protection

What	How
Personal protective equipment (PPE) is that equipment which our forces use to limit their exposure to vectors and other animals they may encounter during contingency operations. Of the many types of PPE that you can suggest to our personnel, examples include the head net, the BDU with sleeves rolled down and pants properly bloused.	Hot weather parka, headnet, bednet, and BDU with sleeves rolled down and top buttoned.
Repellents are chemicals that repel insects and other pests when applied to the skin, clothing, or around living quarters. Examples include DEET, Permethrin, and individual dynamic absorption (IDA) kit.	DEET, which can be applied to the exposed skin, comes in three different packages—a liquid in a 2-ounce (oz) plastic bottle, a cream in a 2 oz plastic tube, or a DEET/sunscreen combination in a plastic tube. Permethrin (.05%) can be applied to uniforms at a rate of 1 can per uniform, and lasts up to 5 hot washings. Permethrin can be sprayed around tents or bednets by a certified pesticide applicator, using 40% Permethrin. IDA kit which contains 40% Permethrin mixed with a half canteen cup of water can be effective for up to 50 washings or the life of the uniform under field conditions.
Barriers	Bednets treated with Permethrin, headnets, screens, and other solid barriers, BDUs.
Avoidance	Avoid breeding areas (e.g., swamps or marshes) and certain terrain features (e.g., holes in trees, vegetation along camp or trails), and dwelling places for vectors (e.g., mud and thatch huts).

Training

We provide field sanitation training to all deployed organizations (e.g., security police, CE, dining facilities, maintenance organizations, and the medical facility). The public health OIC/NCOIC is responsible for ensuring that all 4E0X1 personnel are trained in field sanitation. Another training program we are sometimes involved in is continuing medical readiness training (CMRT). We also conduct continual training during deployments. There are many sources of information available that will supplement your training program. Remember, if you find a gold mine of information; do not just hold onto it for yourself, let others know about it. Three important publications are:

1. FM 21-10-1, *Unit Field Sanitation Team Training Manual*.
2. FM 21-10, *Field Hygiene and Sanitation*.
3. NAVMED P-5010, *Manual of Naval Preventive Medicine, Preventive Medicine for Ground Forces*.

Appendix A lists deployment preventive medicine references that you will find helpful. As you have noticed throughout this volume, we are responsible for giving a lot of guidance and education to other people. Without it, the medical unit would probably see a much larger number of patients. We must strive to increase our knowledge so we can train others more effectively.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

808. Public health threats under field conditions

1. What are the four types of diseases that occur in contingency operations?

2. In the field, what are the countermeasures to prevent respiratory diseases?

3. What is the number one cause of skin disease in the field?

4. Before we can make recommendations on how to avoid hazardous flora and fauna, what is our primary consideration?

5. One of the most important countermeasures in the field is personal hygiene. How is good personal hygiene accomplished?

809. Public health responsibilities during contingency operations

1. What are public health responsibilities in the field?

2. What are some simple rules to follow to prevent foodborne disease outbreaks under field conditions?

3. What organizations receive field sanitation training from public health?

4. Who is responsible for ensuring all 4E0X1 personnel are trained in field sanitation?

2–2. Safe Food and Water

As you learned in previous volumes, food and water must come from approved sources. This is especially important on deployments. Local street vendors will offer a variety of nonapproved food and water sources to our personnel. At times, the only variety of food is operational rations for all three meals. If you are lucky, you may be fortunate enough to be able to eat at a field kitchen. We educate services personnel to take extra care in ensuring the field kitchen is kept clean and the foods are protected to prevent foodborne disease outbreaks. Some believe that food code requirements can be reduced in field conditions; however, just the opposite is true. On deployments, extra care must be taken to ensure our food and water supplies are not contaminated by dusty environments or by an enemy saboteur. Our food and water supplies are items that could be contaminated by an enemy. If food or water is contaminated, the entire unit is vulnerable to disease or illness. It is your job to help prevent that from happening. You must work with services personnel and other medical personnel to ensure our troops are safe from disease. In this section you will study food handling and water in a field environment.

810. Transporting and storing foods

It can be challenging to feed personnel deployed in field conditions. As a rule, when deployed overseas, you should assume food from local vendors is suspect; therefore, foods from approved sources must be transported to us and stored safely. Foods may be transported many miles or stored for long periods of time. We must keep the stressors of time and temperature in mind as we inspect foods in the field.

Transportation

Vehicles used to transport foods must be clean and covered to protect foods from the sun, dirt, insects, rodents, and other sources of contamination. They should not be used for transporting garbage, trash, petroleum products, or other materials that could contaminate the food. In a deployment situation, vehicles are often used for hauling garbage, munitions, supplies, and food. We must ensure the vehicles are thoroughly cleaned prior to transporting food. To prevent contaminating the food, you should recommend that the food facility supervisors and vehicle drivers use clean tarpaulins, bags, or other clean containers. If bulk quantities of meat and dairy products are transported a considerable distance, refrigerated vehicles must be used. Cold and hot foods should be transported as quickly as possible in containers that will maintain their proper temperatures.

Storage

Upon receipt of food products in the food service facility, the unit food service officer or another responsible individual must inspect it. Any food suspected of being unfit for human consumption is referred to the unit public health officer, medical unit commander, or authorized representative for his or her evaluation and recommendation.

Just as foods must be transported in clean vehicles at proper temperatures, they must also be stored in a similar manner. Remember, in a field situation storage facilities will have to be made from the resources available. Keep the following general food storage principles in mind:

- Store foods in clean, covered containers once they have been removed from their original wrappers or containers.
- Store containers of food at least 6 inches (in) above the floor/ground to reduce contamination and facilitate cleaning.
- Do not use galvanized containers to store meat, fruits, salads, tea, coffee, lemonade, fruit juices, or other foods containing acids.
- Foods should be stored out of direct sunlight and in a dry, cool place.
- Storage facilities should be insect and rodent proofed to prevent infestations and food loss.
- When storing food products in tents, bury the tent flaps to prevent rodent access. Ensure screens are in good repair to exclude flies.

Potentially hazardous foods

Although specialized equipment may be limited during field conditions, food safety becomes a more paramount concern. Under field conditions, potentially hazardous foods require the same care as they would in a permanent facility. To ensure the safety of potentially hazardous foods, they should be stored in accordance with the food code.

Perishables

The important thing to remember is refrigeration capabilities will vary from unit to unit and mission to mission. If refrigeration units are available, they will most likely run off generators, which are subject to failure. Therefore, close monitoring of temperatures is essential; and an excellent method for services personnel to use is tracking charts. When a refrigeration outage occurs, have a plan to work with services personnel. Try to salvage as much food as possible because it may be days or even weeks before you get more food. In a more primitive setting, ice chests may be all you have to keep foods cold. Ice used in ice chests and ice that comes into contact with food or food contact surfaces must be potable. Remember, the more primitive the refrigeration facilities, the closer you will have to watch the foods because they will deteriorate more rapidly.

Semiperishable

Semiperishable foods, such as dry goods and canned items, should be stored in clean, sealable containers and protected from excessive heat and moisture. You should check these items frequently for deterioration and rodent or insect problems.

811. Preparing, handling, and serving foods

Facilities

Facilities for preparing and serving food will vary depending upon the unit, its location, number of personnel, and the mission. Although facilities vary, they should all be kept clean and in good repair. The following facility guidelines should be followed:

- They should be as insect and rodent proofed as possible.
- Screening, if available, should be used over open windows. Holes or cracks in the facility should be repaired quickly and tent bottom flaps buried or sandbagged.
- Utensils and food preparation equipment should be stored in protected areas to minimize contamination (like airborne dust from vehicles driving by on a dusty road).
- Sanitizing food contact surfaces cannot be overemphasized. In a dusty, dirty environment, sanitize both before and after food preparation/handling.
- Food and other kitchen wastes need to be disposed of quickly in an acceptable manner to reduce insect and rodent feeding and breeding places.
- If insecticides or rodenticides are used, they should be applied following label directions by certified pest management personnel. Great care should be taken not to contaminate foods and food contact surfaces.

Food employees

During Desert Shield/Storm, one of the major problems in preventing foodborne disease outbreaks was trying to educate contracted food employees from many different nations that spoke different languages. Language barriers may require you to educate food employees through a translator and may require you to perform more frequent inspections for contract compliance. A food employee not following proper foodhandling practices, or with a communicable disease, could cause a foodborne disease outbreak among your deployed forces, rendering them unable to perform their mission. This is why it is important for all food employees to stay healthy and remain knowledgeable about food storage, preparation, and serving procedures. All assigned food employees should be trained in the principles and practices of controlling foodborne disease outbreaks IAW the food code.

The person in charge of the food facility should inspect food employees daily for signs of illness or evidence of infection. Personnel with skin infections, boils, diarrhea, or other signs of illness should *not* be allowed to work until they are examined by a medical officer.

Cleaning and sanitizing utensils and equipment

When facilities and conditions permit, utensils and equipment should be cleaned and sanitized IAW the food code. Under most field conditions, personnel will not have the luxury of having piped-in hot water or automatic dishwashers. Many times, adequate washing and sanitizing equipment will have to be improvised from supplies on hand.

Cleaning procedures

Utensils, equipment, and mess kits must be cleaned and disinfected after each use using a mess kit laundry (fig. 2–2). Immersion heaters are used to heat the water in four 36-gallon (gal) cans. When the immersion heaters are put in the 36 gal cans, it will result in only 20 gal of water, so remember to dose chlorine accordingly. The four cans used in the laundry setup are used for:

1. Scraps—Food waste.
2. Wash water—Contains warm soapy water and a stiff bristle brush.
3. Rinse water—Contains boiling water.
4. Sanitizing—Contains boiling water or sanitizing solution.

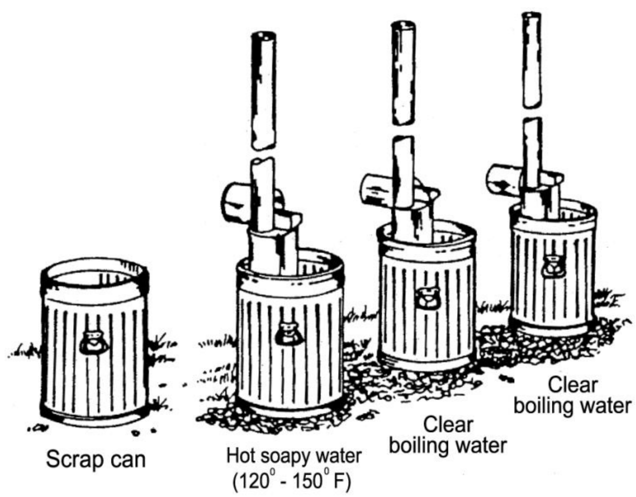


Figure 2–2. Mess kit laundry.

Sanitizing procedures

Utensils and equipment can be sanitized by immersing them in boiling water for 30 seconds, or in a chlorine solution for at least one minute. When hot water is not available, a food service disinfectant may be used for sanitizing; however, a 100-ppm chlorine solution is most commonly used. If using chlorine, the solution can be made by adding one-third canteen cup of 5 percent chlorine bleach to each 10 gal of water, or one mess kit spoonful of calcium hypochlorite to 10 gal of water. A fresh chlorine solution should be made for rinsing and disinfecting utensils for each 100 people. Other sanitizing solutions may also be used as defined in the food code.

Once washing and sanitizing are complete, items must be air-dried in a clean, dust-free place. Educate personnel to rinse their mess kits again just prior to use. Usually services personnel will place a 36 gal can with boiling water just in front of the mess kit trailer so personnel have one last chance to sanitize their kits before food is served to them. Other food contact surfaces may be sanitized by swabbing them with a chlorine solution at least twice as strong as that described above. Remember to keep items protected from contamination.

Serving food

You have already learned basic food preparation and serving techniques, cooking and holding temperatures, and which foods are potentially hazardous. You are going to use these basic principles and adapt them to the different field situations. Hot foods should ideally be served hot (more than 140°F) and cold foods (less than 41°F) served cold. If optimum temperatures cannot be achieved, you should evaluate the situation based on what the food is, how hazardous it is, what temperature is being maintained, and the length of time held at that temperature. Minimize the time between the preparation and serving of food. Thorough cooking and immediate serving will reduce the chances of food becoming contaminated. Also, meals should be planned to reduce the amount of leftovers. Items held at improper temperatures should not be retained as leftovers for reuse. Food code guidelines should be followed as much as possible.

Inspecting food service facilities

Common sense must also be used when inspecting food service facilities. Facilities may range from a tent to an initial deployment kitchen (IDK), or to an actual hardened building. A photograph of the inside of an IDK is shown in figure 2–3. Adjustments may be made based on the facilities available. The purposes of inspecting these facilities are to:

- Ensure basic standards are maintained.
- Identify potential problems that could result in a foodborne disease outbreak.
- Recommend ways to correct problems.
- Provide an opportunity to educate food service personnel in effective food sanitation procedures.

It is very important that you work closely with food service personnel to help prevent foodborne disease outbreaks. Remember, the health and safety of our troops may depend on you.

Figure 2–3. Inside an initial deployment kitchen (IDK).

812. Field water

Water is one of our most vital resources and is necessary for our survival. Without it, the human body will only survive two to five days. Insufficient quantity and quality of drinking water are not only debilitating to the individual, but could have a significant impact on operational readiness.

Preventive medicine personnel assist in selection of field water sources and insure the water is safe to drink by performing inspections and periodic water tests. This lesson provides information and guidance on selection and surveillance of field water.

Sources of water

Water may be obtained from a variety of sources in the field. Below are the most commonly used sources of field water. All water sources should be considered unsafe until treated, tested, and approved for use by the preventive medicine personnel.

Existing public water supply

Existing public water systems are the easiest and, in most cases, the safest sources because this water has been treated to some extent. However, this does not preclude the requirement to test the quality of the water. Water from any source must be tested and meet military standards prior to use.

Surface water

Surface waters such as streams, ponds, rivers, and lakes are generally the most accessible, and are commonly selected for use in the field. They are usually more polluted than other water sources; but in the field, quantity and accessibility requirements are given priority over quality requirements. Simply ensure proper treatment prior to use.

Ground water

Ground water from wells and springs may be selected for use when a surface source is not readily available. Ground water is usually less contaminated than surface water and requires less treatment; however, it is difficult to determine the quantity available. It is also difficult, costly, and time-consuming to drill wells. Because of these disadvantages, the use of ground water in the field is limited unless existing wells are available. Ground water sources must be at least 100 yd from potential sources of contamination such as latrines, and industrial run-off.

Bottle water

Bottled water is sealed in bottles or other containers by a commercial or military source for human consumption. Water that is produced and packaged by the military will conform to established standards. Preventive medicine people will inspect military purification and packaging operations prior to the start of operations. Commercially purchased bottled water must come from approved military sources. A list of military approved sources can be found in VETCOM Circular 40-1, *Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement*, and USAREUR Circular 40-657, *Directory of Sanitarily Approved Food Establishments for Armed Forces Procurement in the Republic of Korea*. Army or DLA quality assurance personnel inspect commercial bottling facilities to ensure compliance with acceptable sanitation standards.

Water purification

Water that is not properly treated and disinfected can spread diseases such as cholera, shigellosis, typhoid, and paratyphoid fever. Untreated water can also transmit viral hepatitis, gastroenteritis, and parasitic diseases such as amoebic dysentery, giardiasis, cryptosporidosis, and schistosomiasis. Although isolated cases of each of these may not be a big problem, imagine what would happen if 80 percent of the personnel in a unit were sick. A contaminated water supply can quickly disable an entire unit, making it impossible for personnel to accomplish their mission. Potable water is free from disease-producing levels of organisms, poisonous substances, chemical or biological agents, and radioactive contaminants. However, potable water may not be palatable. Palatable water is pleasing in appearance and taste. It is free from color, turbidity, taste, and odor. **Palatable water may not be potable.**

Reverse osmosis water purification unit (ROWPU)

The ROWPU is the Air Force's preferred method for purifying water because it reliably provides high quality potable water, even from low quality, contaminated sources. This versatile machine will produce potable water from contaminated sources including fresh, brackish, or saltwater. The intake line of the ROWPU shall be affixed with a strainer. When the source is a body of water (lake, pond, river, stream, etc.), a float or anchor should hold the intake line at least 4 in from the surface or bottom. The effluent line should be positioned so effluent is discharged at least 25 yd downstream from the intake line in the case of flowing surface sources. The ROWPU trailer/pallets must be level and grounded. The filter backwash tank must be filled with brine, and there will be a separate storage tank for raw water, if raw water storage is used. Generator(s) should be grounded and ventilated to prevent carbon monoxide intoxication. A fire extinguisher should be in the immediate area and operators should wear ear protection within 50 ft of operating equipment. Where diseases such as schistosomiasis and leptospirosis are prevalent or chemical warfare agents are likely, operators must wear rubber hip boots and long rubber gloves. Civil engineering personnel use gauge readings to ensure the unit's components are operating properly. Preventive medicine personnel should familiarize themselves with normal readings for the type of unit in use. Figure 2–4 illustrates a typical ROWPU field setup.

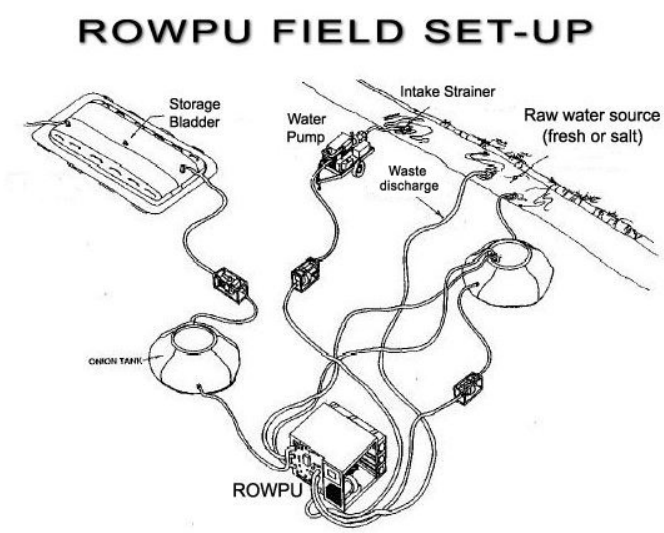


Figure 2–4. Reverse osmosis water purification unit.

Water disinfection

While the ROWPU treats water for physical and chemical contaminants, it does not remove or destroy harmful microbiological organisms. Accordingly, potable water must be disinfected to remove disease-producing organisms. Chlorine is the disinfectant agent specified for military use throughout the tactical water distribution system (TWDS). In the Air Force the TWDS is referred to as the Harvest Eagle Water System. It is the only widely accepted agent that destroys organisms in water and leaves an easily detectable residual (free-available chlorine) that serves as a tracer element. Disappearance of chlorine in potable water signals potential contamination in the system. Sodium hypochlorite (liquid bleach) and calcium hypochlorite powder are the two chemicals used by the military to chlorinate water. Civil engineering personnel are responsible for disinfecting all field water supplies. However, preventive medicine personnel may be asked to provide guidance on the proper disinfecting procedures. Figure 2–5 depicts the potable water disinfection requirements throughout the TWDS.

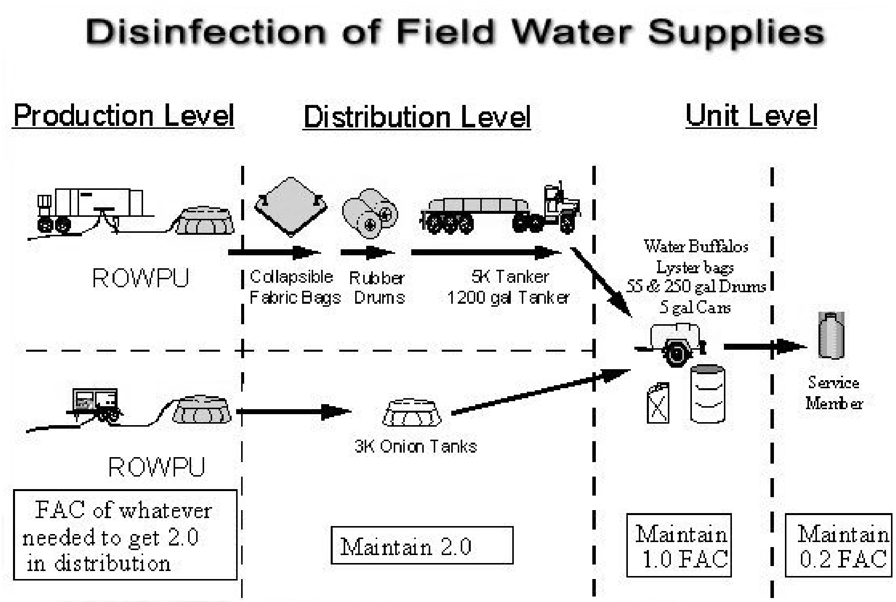


Figure 2–5. Disinfection of field water supplies.

Disinfection of water distribution system

The TWDS consists of water production (600 gph and 3,000 gph ROWPU), storage (800K gal, 300K gal, and 40K gal bladders), and bulk transport (3K gal and 5K gal semitrailer-mounted fabric tanks) systems. Free-available chlorine (FAC) will be maintained at 2 ppm throughout the TWDS. The correct contact time prior to testing is 30 minutes at all points throughout the system.

Disinfection of water treated by other means

Water purified by means other than ROWPU will be disinfected by adding chlorine, at the production site, to maintain a 5 mg/L FAC through the TWDS.

Disinfection at the unit level

FAC will be maintained at 1 ppm in unit-level containers (400 gal trailers, lyster bags, collapsible pillow tanks, and 55 gal and 250 gal drums).

Disinfection at the individual level

FAC will be maintained at 0.2 ppm at the individual service member level (canteen).

Emergency disinfection

When away from supply lines and treated water is not available, individual service members must select the clearest, cleanest water with the least odor and treat the water using individual water purification means. Preventive medicine personnel will brief troops on the following emergency disinfection procedures:

Name	Procedure
Iodine	When treated water is not available, individuals must disinfect their own water using iodine tablets. Usable and effective iodine tablets should be blue-green in color. Two iodine purification tablets added to a canteen (1qt) of water releases 16 ppm/mgl of iodine as a disinfecting agent. To use these tablets, place the tablets into the canteen. After five minutes shake the canteen, loosen the canteen cap, and allow the iodine-treated water to seep around the neck of the canteen to kill any organisms harbored there. A minimum contact time of 60 minutes is required for water disinfection using the iodine purification tablets. At the present time there is no field method used to determine the iodine residual.
Chlor-Floc	One of the shortcomings of the iodine water treatment is that it doesn't remove suspended solids and it doesn't kill some disease-causing organisms. The newest method for the emergency treatment of individual water supply in the field is the Chlor-Floc water treatment kit. It is intended for the clarification and disinfection of the individual's canteen water supply. Chlor-Floc tablets contain a combination of flocculation (chemical suspending particles) and coagulating (forming into a thickened mass) agents and chlorine that promote rapid formation of sediment in the treated water. Pollutants and microscopic particles adhere to the sediment and settles out by gravity. The clarified water is strained through the provided canteen flannelette filter, removing even more solids. After clarification of the water by separating the sediment from the treated water, the chlorine released by the tablet is free to kill giardia lamblia cysts, bacteria, viruses, and other pathogens. Each kit comes with 30 Chlor-Floc tablets, one treatment bag, one canteen flannelette, and easy-to-follow instructions.
Boiling	Boiling is not the best field-water disinfection method since there is no residual protection against recontamination. Use boiling water when other disinfecting compounds are not available. Boiling water at a rolling boil for five to 10 minutes kills most organisms that are known to cause intestinal diseases. You must be careful to use clean containers for boiling the water. After boiling, the water must be stored in a clean, closed container to prevent recontamination.

813. Water storage inspections

Preventive medicine personnel will perform periodic inspections of the TWDS to ensure potability of the water and sanitary conditions. Inspection results must be documented. A copy of the inspection report should be left with the inspected unit. Below are the inspections that fall into the preventive medicine area of responsibility.

General site conditions

No pollution sources shall exist nearer than 2 miles upstream or upgradient from the water source (river, lake, etc.) Drainage must be adequate to prevent ponding at distribution points. Dust control measures will be employed to prevent dustborne bacteria from contaminating water and equipment. Rodent and insect breeding areas must be controlled to prevent the spread of disease. Garbage and trash must be properly stored and disposed to prevent contamination of the water source or system.

400 gal water trailer (water buffalo)

Manhole covers will seal effectively to prevent contamination. Rubber gaskets will be intact and not have cracks, missing pieces, excessive dry rot, or improper fit. The manhole cover locking mechanism will be functional. The manhole cover and tank interior will not be rusted. Spigots will be functional. Locking devices for spigot covers will be functional. Drain plugs should be hand-tight and easy to remove. Stains caused by natural water impurities, such as iron and manganese, are permitted. However, stains resulting from rust, storage of unauthorized liquids, or improper painting are not permitted. Chips or cracks in the interior surface are ideal areas for biological growth and contamination. Trailers where more than 10 percent of the interior is chipped or cracked or where the fiberglass subsurface is exposed will be put out of service and repaired. Flaking of the interior surface paint may result from use of unauthorized paint or improper surface preparation. Trailers with excessive flaking of interior surfaces should be put out of service and repaired.

When the water trailer arrives in the unit area from a filling point, always check the chlorine residual. This accomplishes and verifies two things:

1. The driver went to an approved water point.
2. The water point is maintaining the correct chlorine residual in the water.

The chlorine residual should be at 1 ppm (FAC) or the level established for the area of operation. If the residual meets the required standard, the water is safe to drink; if not, the water must be rechlorinated to the required level. After rechlorination the water must be checked periodically to maintain the minimum required level. Heat and sunlight will cause chlorine to dissipate more rapidly. Therefore, periodic rechlorination may be required. To rechlorinate a full water buffalo follow these steps:

1. Use one mess kit spoonful of calcium hypochlorite, or mix three MRE spoonfuls of calcium hypochlorite, or 27 ampules of calcium hypochlorite dissolved in one-half canteen cup of water.
2. Flush the four water spigots for several seconds.
3. Wait 30 minutes, then flush the spigots again and check the chlorine residual. If the residual is at least 1 ppm (FAC) or greater, release the water for consumption.
4. If the residual is below 1 ppm (FAC) additional chlorine must be added to the water. Mix a slurry as before; however, the amount of chlorine required may be less than three MRE spoonfuls, estimate the amount needed.
5. After adding the new batch, the 10-minute waiting time, flushing, and testing procedures as above must be repeated.

Lyster bag

The 36 gal Lyster bag is issued to units on the basis of one per 100 persons. If the fabric material has been repaired, patches or temporary plugs must be secure. The check-valve adapter must be undamaged and open easily. Dust caps must be attached to couplers when not in use. The Lyster bag must be cleaned before it is used. Also, it must be hung away from areas that could cause potential contamination, such as a tree. Before it is filled with water (fig. 2–6), clean the bag with a solution made with one ampule of calcium hypochlorite dissolved in one gal of water. Fill the cleaned bag only to within 4 in from the top. Then, flush the faucets with a small quantity of water. After 10 minutes flush the faucets again, and determine the chlorine residual. The calcium hypochlorite ampules are issued for convenience. Each ampule contains 0.5 gram of calcium hypochlorite and gives a chlorine dosage of approximately 2 ppm (FAC) when added to the water in the Lyster bag. Use as many ampules as necessary to provide the required 1 ppm (FAC) chlorine residual after a 30-minute contact period.

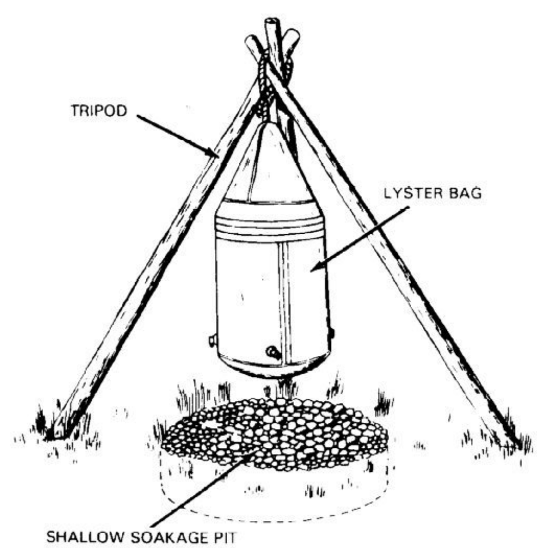


Figure 2–6. Lyster bag.

Water trailers/trucks

Inspection criteria for manhole covers are the same as for 400 gal buffalos. Dispensing valves should operate freely and close tightly. Threads on hose couplings should be intact and undamaged. Dust caps must be attached to dispensing valves except when valves are in use. The mesh screen inside the filling port and the tank interior should be free of rust. Metal interiors will not be painted. The required chlorine residual at a water trailer is 2 ppm (FAC).

Water monitoring

During peactime, bioenvironmental engineering personnel are responsible for testing potable water sources. However, with the development of new preventive medicine UTCs, public health personnel are required to perform field water source selection and testing more and more. Generally, public health personnel will be responsible for performing chlorine/pH and microbacteriogical water testing.

Chlorine and pH testing

CE water production/distribution personnel will check the water from purification equipment for chlorine residual pH every 30 minutes of the operating day. Also, they will check bulk storage and distribution points every hour and check water trailers daily. Preventive medicine personnel must test host nation water, and/or potable water from military purification equipment, storage tanks, distribution points, field kitchens, and latrines for FAC and pH on a weekly basis. The bulk containers should also be tested after each refill. There are two primary chlorine residual testing kits available in the Air Force inventory. They are the Hach DPD kit and the orthotoludine water test kit. Both kits come with a color comparator and instructions to determine the chlorine residual and pH of the water.

Microbiological testing of water

The test is primarily for testing the quality of treated water, bottled water, and swimming pool water. Preventive medicine personnel must test host nation water, and/or potable water from military purification equipment, storage tanks, distribution points, field kitchens, and latrines for bacteria on a weekly basis. The indicator organisms we use to determine if water is contaminated are *coliforms*. Coliform determination has been used as a measure of water contamination for over 70 years. It is valuable not because coliforms are pathogenic, but because they are always present in the normal intestinal track of humans and warm-blooded animals. They are found in great numbers in fecal wastes. Since they have these characteristics and die off after pathogenic bacteria, they are used as "indicator organisms" to indicate the presence of fecal contamination of drinking water. The presence of coliforms may not indicate that the water is hazardous but their absence provides reasonable evidence of water safety. Protozoa, bacteria, viruses, fungi, and parasitic worms are the result of animal and human defecation and hence the presence of coliforms may indicate their presence as well. The acceptable level of coliforms per 100 ml for drinking water is 1 coliform forming unit (CFU). Any counts greater than this requires retesting and two successive negative results to be approved. Ensure proper levels of chlorination are maintained. The two primary kits used by the DOD for testing drinking water are Colilert (presence/absence) and Millipore (membrane filter). These kits are not complicated to use; however, they require hands-on training. Therefore, we suggest you either learn them from your local bioenvironmental engineering office, or attend the Contingency Public Health Operations Course (CONOPS) at USAFSAM.

Superchlorination

This process is used to disinfect water containers and distribution systems initially (before they are used) or when they have become contaminated. Superchlorination is accomplished by chlorinating the water in a container or distribution system to at least 100 ppm (FAC) residual and holding it in the container for four hours. During that time the FAC must not drop below 50 ppm; otherwise, the process must be repeated. The words **"Poison Do Not Drink"** must be displayed clearly on all sides of the container or at all water outlets during the process. Superchlorination can be accomplished through the following steps:

1. Fill the water container or line with water containing at least 100 ppm. A higher concentration may be desirable, depending on the extent of the contamination in the

container, to ensure the residual does not drop below 50 ppm after the four-hour contact time. Refer to *Chlorine Dosage Calculator* (see below) for the amount of calcium hypochlorite granules or sodium hypochlorite bleach to use for the volume of the container or water pipes to be disinfected.

2. Determine the resulting FAC using a chlorine test strip.
3. Measure the FAC residual again after a four-hour contact time. The FAC must be at least 50 ppm at this time. If the FAC is below 50 ppm, the superchlorination procedure must be repeated.

After superchlorination has been completed, drain the container or pipes, rinse them thoroughly, and fill them with potable water from an approved source.

Sodium Hypochlorite Dosage Calculator

Desired Parts Per Million	**1**	**1**	**1**	**1**	**5**	**5**	**5**	**5**
Strength of Chlorine Solution	**5%**	**10%**	**15%**	**16%**	**5%**	**10%**	**15%**	**16%**
Gallons of Water to be Chlorinated								
50000	1.0 gal 3785 cc	2.0 qt 1892 cc	42.7 oz 1262 cc	40.0 oz 1183 cc	5.0 gal 18925 cc	10.0 qt 9463 cc	213.3 oz 6308 cc	200.0 oz 946 cc
25000	2.0 qt 1892 cc	1.00 qt 946 cc	21.33 oz 631 cc	20.00 oz 591 cc	10.0 qt 9463 cc	5.0 qt 4731 cc	106.7 oz 3154 cc	100.0 oz 2957 cc
10000	25.6 oz 757.0 cc	12.80 oz 378.5 cc	8.53 oz 252.3 cc	8.00 oz 236.6 cc	128.0 oz 3785 cc	2.0 qt 1892 cc	42.67 oz 1262 cc	40.0 oz 1183 cc
5000	12.8 oz 378.5 cc	6.40 oz 189.2 cc	4.27 oz 126.2 cc	4.00 oz 118.3 cc	2.0 qt 1892 cc	1.0 qt 946.0 cc	21.33 oz 630.8 cc	20.0 oz 591.4 cc
2000	5.1 oz 151.4 cc	2.56 oz 75.7 cc	1.71 oz 50.5 cc	1.60 oz 47.3 cc	25.6 oz 757.0 cc	12.8 oz 378.5 cc	8.53 oz 252.3 cc	8.0 oz 236.6 cc
1000	2.56 oz 75.70 cc	1.28 oz 37.85 cc	0.85 oz 25.23 cc	0.80 oz 23.66 cc	12.80 oz 378.5 cc	6.40 oz 189.2 cc	4.27 oz 126.2 cc	4.00 oz 118.3 cc
500	1.28 oz 37.85 cc	0.64 oz 18.92 cc	0.43 oz 12.62 cc	0.40 oz 11.83 cc	6.40 oz 189.2 cc	3.20 oz 94.62 cc	2.13 oz 63.08 cc	2.00 oz 59.14 cc
200	0.51 oz 15.14 cc	0.26 oz 7.57 cc	0.17 oz 5.05 cc	0.16 oz 4.73 cc	2.56 oz 75.70 cc	1.28 oz 37.85 cc	0.85 oz 25.23 cc	0.80 oz 23.66 cc
100	0.26 oz 7.57 cc	0.13 oz 3.78 cc	0.09 oz 2.52 cc	0.08 oz 2.37 cc	1.28 oz 37.85 cc	0.64 oz 18.92 cc	0.43 oz 12.62 cc	0.40 oz 11.83 cc
50	0.13 oz 3.78 cc	0.06 oz 1.89 cc	0.04 oz 1.26 cc	0.04 oz 1.18 cc	0.64 oz 18.92 cc	0.32 oz 9.46 cc	0.21 oz 6.31 cc	0.20 oz 5.91 cc
25	0.06 oz 1.89 cc	0.03 oz 0.95 cc	0.02 oz 0.63 cc	0.02 oz 0.59 cc	0.32 oz 9.46 cc	0.16 oz 4.73 cc	0.11 oz 3.15 cc	0.10 oz 2.96 cc
10	0.03 oz 0.76 cc	0.01 oz 0.38 cc	0.01 oz 0.25 cc	0.01 oz 0.24 cc	0.13 oz 3.78 cc	0.06 oz 1.89 cc	0.04 oz 1.26 cc	0.04 oz 1.18 cc

$$\text{Ounces of Sodium Hypochlorite for 1 ppm solution} = \frac{1}{1{,}000{,}000} \times \frac{\text{gallons of water to be chlorinated}}{\text{Strength of chlorine solution}} \times \frac{\text{128 fluid ounces}}{\text{gallon}}$$

Conversion Factors:

1 gallon (gal) = 4 quarts (qt)
1 gallon = 8 pints (pt)
1 gallon = 128 Fluid Ounces (oz)
1 gallon = 3785.41 Cubic Centimeters (cc)
1 quart = 946.35 Cubic Centimeters
1 pint = 473.18 Cubic Centimeters
1 Fluid Ounce = 29.57 Cubic Centimeters

Calcium Hypochlorite Dosage Calculator								
Desired Parts Per Million	1	1	1	1	5	5	5	5
Strength of Chlorine Solution	55%	60%	65%	70%	55%	60%	65%	70%
Gallons of Water to be Chlorinated: 50000	12 oz 344 grams	11.12 oz 315 grams	10.26 oz 291 grams	9.53 oz 270 grams	60.7 oz 1720 grams	55.60 oz 1576 grams	51.32 oz 1455 grams	47.66 oz 1351 grams
25000	6.07 oz 172 grams	5.56 oz 158 grams	5.13 oz 146 grams	4.77 oz 135 grams	30.3 oz 860 grams	27.80 oz 788 grams	25.66 oz 728 grams	23.83 oz 676 grams
10000	2.43 oz 69 grams	2.22 oz 63 grams	2.05 oz 58 grams	1.91 oz 54 grams	12.1 oz 344 grams	11.12 oz 315 grams	10.26 oz 291 grams	9.53 oz 270 grams
5000	1.21 oz 34 grams	1.11 oz 32 grams	1.03 oz 29 grams	0.95 oz 27 grams	6.07 oz 172 grams	5.56 oz 158 grams	5.13 oz 146 grams	4.77 oz 135 grams
2000	0.49 oz 13.8 grams	0.44 oz 12.61 grams	0.41 oz 11.64 grams	0.38 oz 10.81 grams	2.43 oz 68.8 grams	2.22 oz 63.05 grams	2.05 oz 58.20 grams	1.91 oz 54.04 grams
1000	0.24 oz 6.88 grams	0.22 oz 6.31 grams	0.21 oz 5.82 grams	0.19 oz 5.40 grams	1.21 oz 34.4 grams	1.11 oz 31.53 grams	1.03 oz 29.10 grams	0.95 oz 27.02 grams
500	0.12 oz 3.44 grams	0.11 oz 3.15 grams	0.10 oz 2.91 grams	0.10 oz 2.70 grams	0.61 oz 17.2 grams	0.56 oz 15.76 grams	0.51 oz 14.55 grams	0.48 oz 13.51 grams
200	0.05 oz 1.38 grams	0.04 oz 1.26 grams	0.04 oz 1.16 grams	0.04 oz 1.08 grams	0.24 oz 6.88 grams	0.22 oz 6.31 grams	0.21 oz 5.82 grams	0.19 oz 5.40 grams
100	0.02 oz 0.69 grams	0.02 oz 0.63 grams	0.02 oz 0.58 grams	0.02 oz 0.54 grams	0.12 oz 3.44 grams	0.11 oz 3.15 grams	0.10 oz 2.91 grams	0.10 oz 2.70 grams
50	0.01 oz 0.34 grams	0.01 oz 0.32 grams	0.010 oz 0.29 grams	0.010 oz 0.27 grams	0.06 oz 1.72 grams	0.06 oz 1.58 grams	0.05 oz 1.46 grams	0.05 oz 1.35 grams
25	0.01 oz 0.17 grams	0.006 oz 0.16 grams	0.005 oz 0.15 grams	0.005 oz 0.14 grams	0.03 oz 0.86 grams	0.03 oz 0.79 grams	0.026 oz 0.73 grams	0.024 oz 0.68 grams
10	0.00 oz 0.07 grams	0.002 oz 0.06 grams	0.002 oz 0.06 grams	0.002 oz 0.05 grams	0.01 oz 0.34 grams	0.01 oz 0.32 grams	0.010 oz 0.29 grams	0.010 oz 0.27 grams

Notes: Figures expressed in ounces are in dry ounces not fluid ounces. Where two figures are shown, use one or the other, not both.

$$\text{Ounces of Calcium Hypochlorite for 1 ppm solution} = \frac{1}{1{,}000{,}000} \times \frac{\text{gallons of water to be chlorinated}}{\text{Strength of chlorine solution}} \times \frac{16 \text{ ounces}}{\text{pound}} \times \frac{8.34 \text{ pounds}}{\text{gallon}}$$

Conversion Factors

1 ounce (oz) = 28.35 grams
1 pound (lb) = 453.59 grams
1 pound = 16 ounces
1 gallon of water weighs 8.34 pounds

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

810. Transporting and storing foods

1. Why should vehicles used to transport food be clean and covered?

2. List the principles for storing food in field situations.

3. How should potentially hazardous foods be stored?

4. What is the requirement for ice used in ice chests and ice that comes in contact with food or food contact surfaces?

5. How should semiperishable foods be stored?

811. Preparing, handling, and serving foods

1. Where should utensils and equipment be stored to minimize contamination?

2. Why do food and other kitchen wastes need to be disposed of quickly and in an acceptable manner?

3. What should be used to train permanently assigned food employees?

4. Why should the food facility supervisor inspect food employees daily?

5. Which food employees should *not* be allowed to work until they are examined by a medical officer?

6. When are utensils and equipment cleaned and disinfected?

7. How can utensils and equipment be disinfected?

8. Why are food service facilities inspected in field conditions?

812. Field water

1. List possible sources of water for a deployed unit.

2. Which water source is most commonly selected for use in the field? Why?

3. What two chemical agents are most commonly used for chlorinating water in the field by the military?

4. After adding two iodine purification tablets to a canteen of water and shaking for five minutes, how much contact time is required before the water is considered safe to consume?

5. List three different methods of disinfecting water.

6. What is the biggest disadvantage of boiling to disinfect drinking water?

813. Water storage inspections

1. A large trailer of water has been chemically treated with chlorine. What is the minimum chlorine residual necessary for drinking water to be considered safe?

2. In a deployed environment, how often should CE water production/distribution personnel check the water from purification equipment for chlorine residual and pH?

2–3. Waste Disposal

The proper disposal of all wastes is essential in preventing the spread of disease. Liquid and solid wastes produced under field conditions may amount to 100 lb per person, per day. A camp without proper waste disposal methods soon becomes an ideal breeding area for flies, rats, and other vermin and may result in diseases such as dysentery, typhoid, paratyphoid, and cholera among personnel. In this section, you'll study disposal methods of human waste, garbage, and medical waste. The methods selected for use will depend upon the location of the unit and the military situation. Generally, wastes are buried if the environment, especially soil conditions, and local regulations permit.

814. Human waste disposal in field conditions

Human waste disposal becomes a problem for both the individual and the unit in the field. Latrines are constructed to prevent the contamination of food, water, and the environment. The basic sanitary requirements for latrines are:

1. They must be located at least 100 yd downwind from food service facilities and at least 100 ft downstream from any unit ground water source.
2. Latrines must not be dug to the ground water level or in places where pit contents may drain into the water source.
3. They must be built at least 30 yd from the border of a unit area but within reasonable distance for easy access.

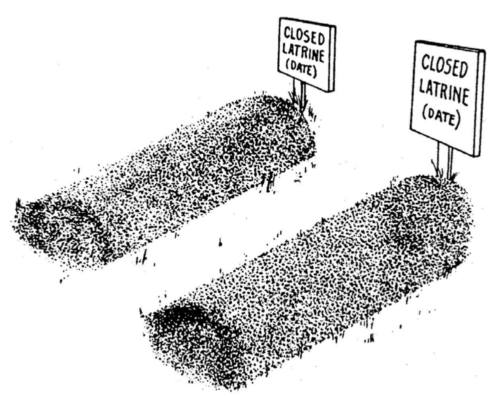
4. A drainage ditch should be dug around the edges of the latrine enclosure to keep out rainwater and other surface water.

At a minimum, handwashing devices are installed at each latrine enclosure and in front of dining facilities. These devices should be easy to operate and provided with ample soap and water. Each person must wash his or her hands after using the latrine and prior to eating. As a guideline, enough latrines to service four percent of the male population and six percent of the female population within the command should be provided.

Closing latrines

When a latrine is filled to within 1 ft of the ground surface or when it is to be abandoned, it is closed in the following manner:

1. The pit is filled to the ground surface in 3 in layers of dirt, each layer being compacted and sprayed with a residual insecticide. This is to prevent fly pupae from hatching and gaining access to the open air.
2. Dirt is then compacted over the pit to form a mound at least 1 ft high. This will provide a 24-in dirt cover over the waste before closing.
3. A sign is posted with the date and the words "closed latrine," if the tactical situation permits (fig. 2–7).



Note: Dirt mounds should be at least 1 foot high.

Figure 2–7. Closed latrine.

Types of latrines

Under field conditions, numerous types of latrines are used—cat-hole, straddle trench, deep pit, burn-out, mound, pail, and chemical. The field unit's length of stay usually determines the type of latrine that is used.

Length of Stay	Type of Latrine
Short stays (i.e., one day or less), when troops are on a march.	A "cat-hole" latrine dug approximately 1 ft deep and completely covered and packed down with dirt after use.
Temporary stays (i.e., 1 to 3 days).	Straddle trench latrine unless more permanent facilities are provided for the unit.
Temporary camp (i.e., two weeks or less).	Deep pit latrine and urine soakage pits.

Cat-hole latrine

The cat-hole latrine (fig. 2–8) is used and dug by each person for his or her individual use. It is most frequently used by armed forces personnel on the go.

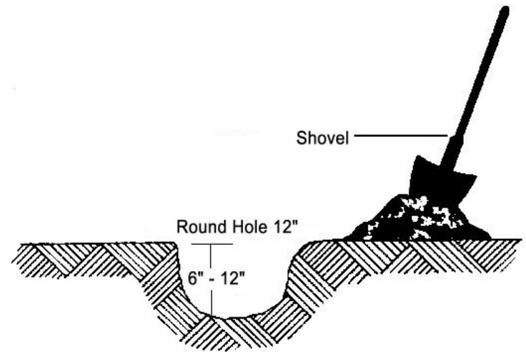


Figure 2–8. Cat-hole latrine.

Straddle trench latrine

For a straddle trench latrine (fig. 2–9), a trench is dug 1 ft wide, 2$^1/_2$ ft deep, and 4 ft long. Two feet of length are allowed per person. The trenches are constructed parallel to one another, at least 2 ft apart. As a general rule, remember to construct enough straddle trenches for 4 percent of the male population and 6 percent of the female population. Since there are no seats on this type of latrine, boards may be placed along both sides of the trench to provide sure footing. As the earth is removed, it is piled at one end of the trench. A shovel or paddle is provided so each person can promptly cover his or her excreta. Toilet paper is placed on suitable holders and protected from bad weather by a tin can or other covering.

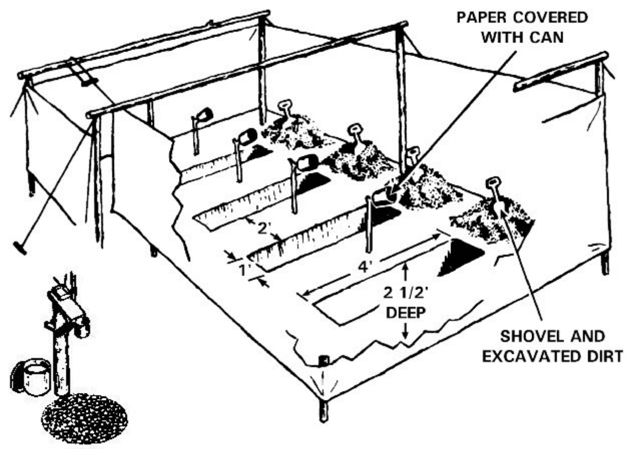


Figure 2–9. Straddle trench latrine.

Deep pit latrine

This type latrine (fig. 2–10) is a deep pit with the standard latrine box placed over it, and is used for longer periods of time. The two-seat box is 4 ft long, 2$^1/_2$ ft wide at the base, and 18 in high. A four-seat box is 8 ft long, 2$^1/_2$ ft wide at the base, and 18 in high. The pit is dug 2 ft wide and either 3$^1/_2$ or 7$^1/_2$ ft long, depending upon the size of the latrine box. This allows 3 in of earth on each side of the pit to support the latrine box. The depth of the pit depends on the estimated length of time the latrine is going to be used. As a guide, a depth of 1 ft is allowed for each week of estimated use, plus 1 ft of depth for dirt cover. Generally, it is not desirable to dig the pit more than 6 ft deep because of the danger of the walls caving in. Rocks or high ground water levels may also limit the depth of the pit. In some soils, planking supports or other material may be necessary to prevent the walls from caving in. To prevent fly breeding and to reduce odors, the latrine box must be kept clean, the lids closed, and all cracks sealed. If a fly problem exists, they may be controlled by the application of a residual pesticide. Controls should be based on fly surveys, and pesticides applied in accordance with label directions. Pit contents should not be sprayed routinely because flies can develop resistance to pesticides repeatedly used. The latrine boxes and seats are scrubbed daily with soap and water.

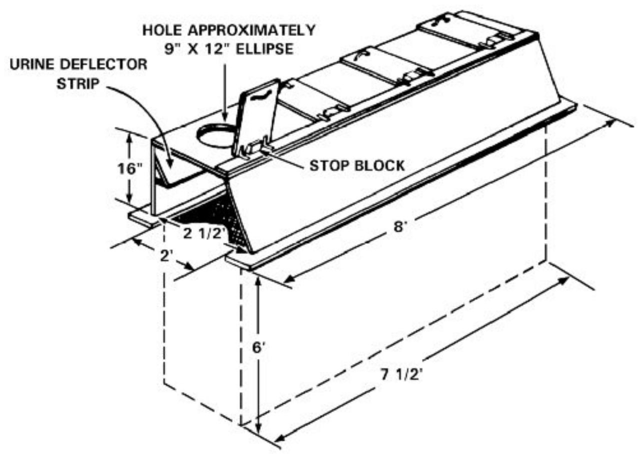


Figure 2–10. Deep pit latrine.

Burn-out latrine

The burn-out latrine (fig. 2–11) may be provided when it is difficult to dig a deep pit latrine (e.g., the soil is hard, rocky, or frozen). It is particularly suitable in areas with high water tables because digging a deep pit is impossible. The burn-out latrine is not used when regulations prohibit open fires or air pollution. Personnel should urinate in a urine disposal facility rather than the burn-out latrine because more fuel is required to burn out the liquid. To construct a burn-out latrine, an oil drum is cut in half, and handles are welded to the sides of the half drum for easy carrying. A wooden seat with a fly-proof, self-closing lid is placed on top of the drum. The latrine is burned out daily by adding sufficient fuel to incinerate the fecal matter. Highly volatile fuel, such as JP4, should not be used because of its explosive nature. A mixture of 1 quart (qt) of gasoline to 4 qt of diesel oil is effective, but must be used with caution. It is convenient to have two sets of drums; one set for use while the other set is being burned clean. If the contents are not rendered dry and odorless by one burning, they should be burned again. Any remaining ash should be buried.

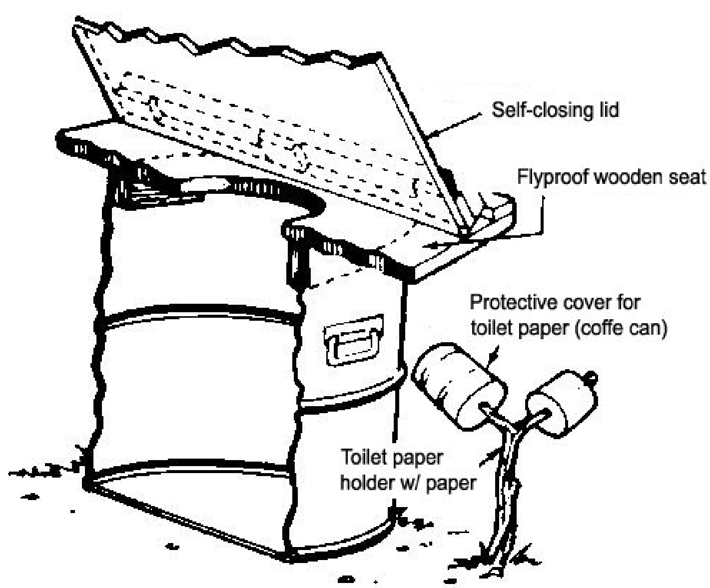


Figure 2–11. Burn-out latrine.

Mound latrine

This latrine (fig. 2–12) may be used when high ground water level or a rock formation near the ground surface prevents digging a deep pit. A dirt mound makes it possible to build a deep pit and still not extend it into the ground water or rock. A mound of earth with a top at least 6 ft wide and 12 ft long is formed so that a four-seat latrine box may be placed on top of it. It is made high enough to meet the pit's requirement for depth, allowing 1 ft from the base of the pit to the level of the ground water or rock level. The mound is formed in approximately 1 ft layers. The surface of each layer is compacted before adding the next layer. When the desired height is reached, the pit is then dug in the mound. Wood or other bracing may be needed to prevent the pit walls from caving in. An alternate method is to construct a latrine pit on top of the ground using lumber, logs, corrugated sheet metal, or whatever other material is available. Next, pile dirt around the pit and up to the brim, thus creating the mound around the latrine pit. The exact size of the mound base depends upon the type of soil. The mound base should be made large enough to avoid a steep slope. It may be necessary to provide steps up the slope.

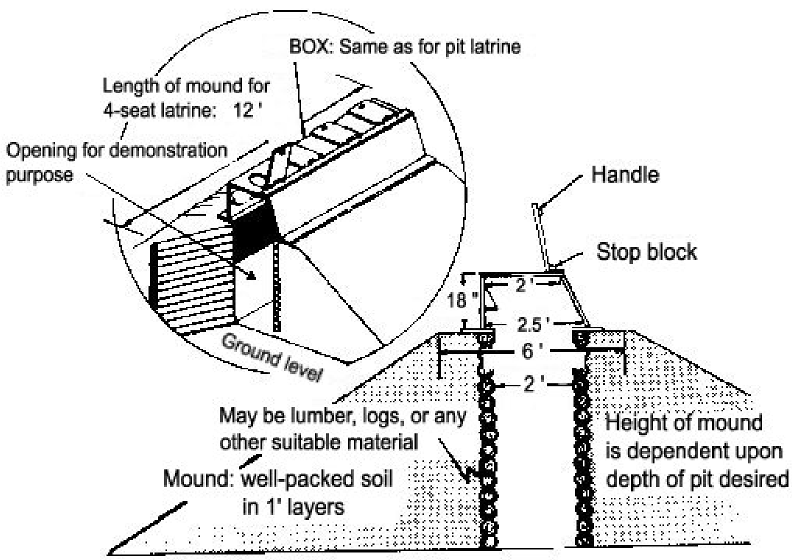


Figure 2–12. Mound latrine.

Pail latrine

A pail latrine (fig. 2–13) may be built when surrounding conditions (e.g., populated areas, rocky soil, marshes) do not allow other types of latrines to be constructed. A four-seat latrine box may be converted for use as a pail latrine by placing a hinged door on the rear of the box, adding a floor, and placing a pail under each seat. If the box is located in a building, it should, if possible, be fitted into an opening made in the outer wall so that the rear door of the box can be opened from outside the building. The seats and rear door should be self-closing, and the entire box should be made fly-proof. The floor of the box should be made of an impervious material (preferably concrete) and should slope enough toward the rear to facilitate rapid water drainage used in cleaning the box. The waste in the pails may be disposed of by burning or burying. Emptying and hauling containers of waste must be done carefully to prevent careless spillage. The use of plastic bag liners for pails reduces the risk of accidental spillage. The filled bags are tied at the top; then are disposed of by burning or burial.

Chemical latrines

Chemical latrines are used in the field when federal, state, or local laws prohibit the use of other field latrines. These toilets are self-contained because they have a holding tank with chemical additives to aid in decomposition of the waste and to control odor. The medical authority in the area of operation establishes how many of these facilities are required in that area. The facility must be cleaned daily and the contents pumped out for disposal in a conventional sanitary waste-water system. The frequency of emptying is determined by the demand for use of the device.

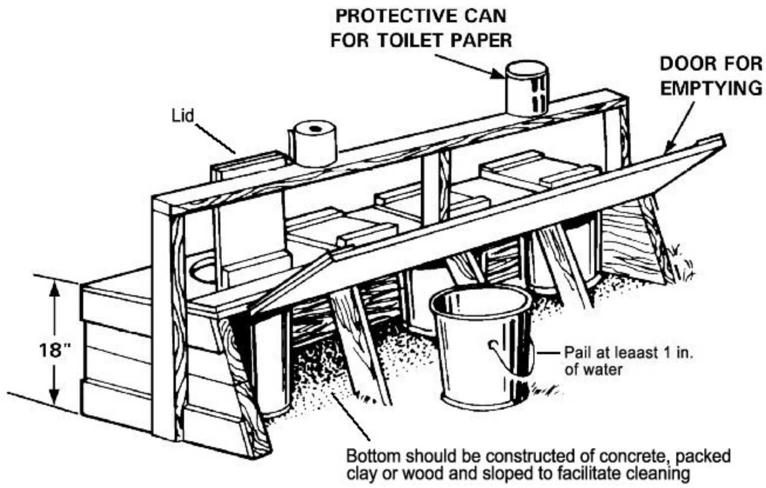


Figure 2–13. Pail latrine.

Urine disposal

Urine disposal facilities should be provided for males, and they should be collocated with the latrine. These facilities prevent soiling of toilet seats and discourage males from urinating in burned-out latrines. (It becomes very difficult to burn urine in burn-out latrines.)

Urine should be drained from the urinals either into a soakage pit, a deep pit latrine, or a chemical latrine. The urine may be drained into a pit latrine through a pipe, hose, or trough. If a soakage pit is used, it should be dug 4 ft square and 4 ft deep and filled with rocks, flattened tin cans, bricks, broken bottles, or similar nonporous rubble. The types of urinals that can be used in the field are urinal pipe, urinal trough, and urinoil.

Urinal pipes

Urinal pipes (fig. 2–14) should be at least 1 inch in diameter and approximately 36 in long. They should be placed at each corner of a soakage pit and, if needed, on the sides halfway between the corners. The pipes are inserted at least 8 in below the surface of the pit with the remaining 28 in slanted outward above the surface. A funnel of tarpaper, sheet metal, or similar material is placed in the top of each pipe and covered with a screen.

Urinal trough

A urinal trough (fig. 2–15) is provided when material for its construction is more readily available than pipes. The trough, which is about 10 ft long, is made of sheet metal or wood with either V- or U-shaped ends. If the trough is made of wood, it is lined with a nonabsorbent material (e.g., tar paper or metal). The legs supporting the trough are cut slightly shorter on the end where a pipe carries the urine into a soakage pit or latrine pit.

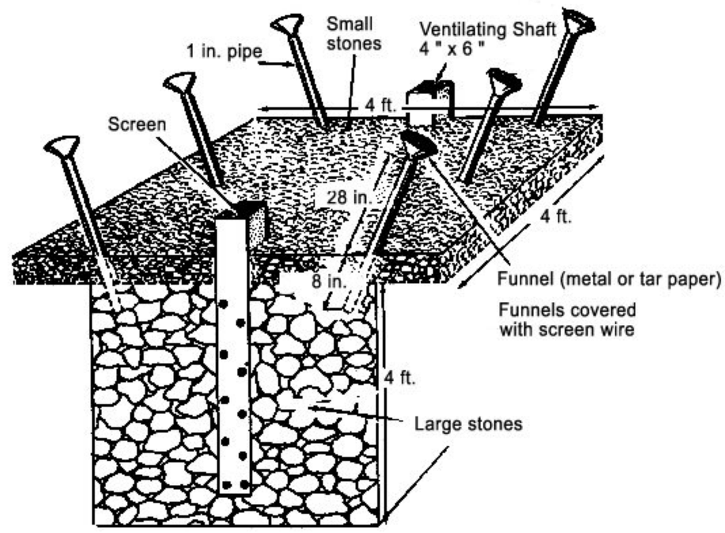


Figure 2–14. Urinal pipes.

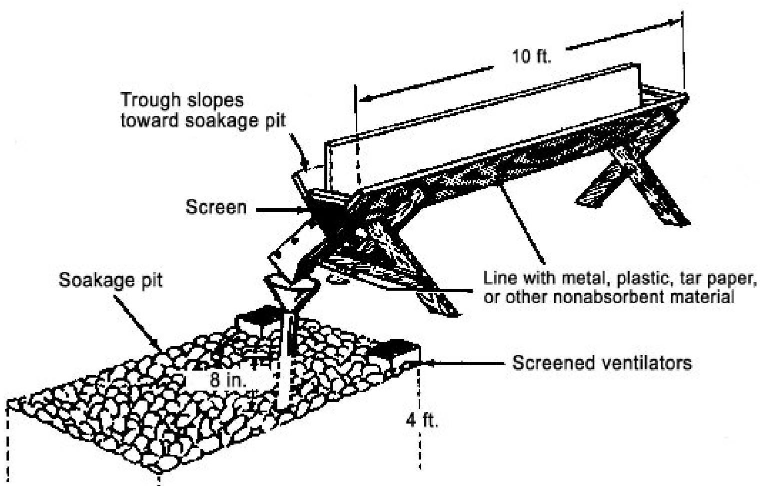


Figure 2–15. Urinal trough.

Urinoil

In areas where the ground water level is more than 3 ft below the surface, the urinoil (fig. 2–16) is an acceptable substitute for other types of urine disposal facilities. The urinoil is a 55 gal drum designed to receive and trap urine and then dispose of it into a soakage pit. Urine voided through the screen onto the surface of the oil immediately sinks through the oil to the bottom of the drum. As urine is added, the level rises within the 3-in diameter pipe and overflows into the $1^1/_2$-in diameter pipe through the notches cut in the top of this pipe. The oil acts as an effective seal against odors and fly entrance. The screen on top of the oil is lifted by supporting hooks and cleaned of debris as necessary.

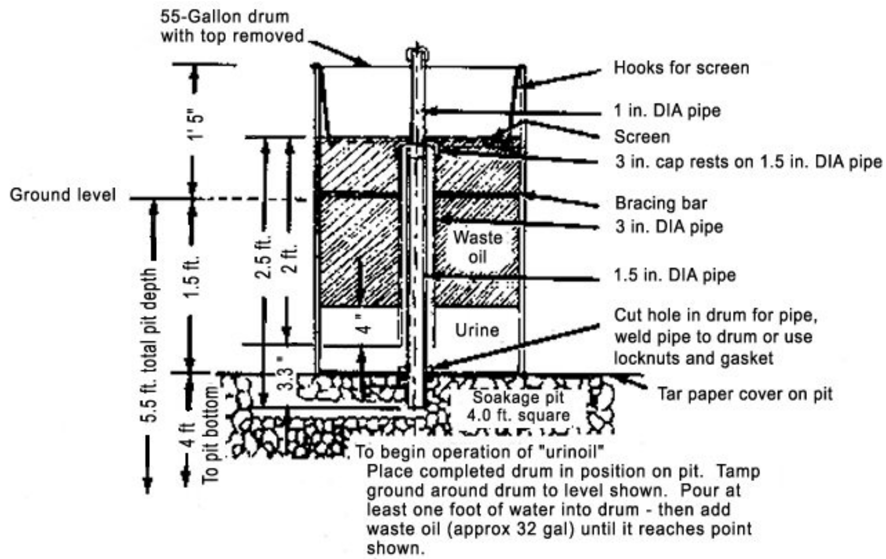


Figure 2–16. Urinoil.

For urine soakage pits to function properly, personnel must not urinate on the surface of the pit. The funnels or trough must be cleaned daily with soap and water and the funnels replaced as necessary. Oil and grease must never be poured into the pit because both substances will clog it. When a urine soakage pit is to be abandoned or it becomes clogged, it is sprayed with a residual insecticide and mounded over with a 2-ft covering of compacted earth.

815. Garbage and medical waste disposal in field conditions

Garbage (food wastes) and rubbish (nonfood trash) is disposed of by burial or incineration; tactical requirements must be considered in either case. The excavated soil must be concealed; however, smoke and flame may not be tolerated in a tactical situation. In a training situation, environmental protection may rule out burning or burying; therefore, garbage will have to be collected and hauled away to a landfill. We will discuss two methods of garbage disposal—burial and incineration.

Burial

Garbage must not be buried within 100 ft of any natural source of water (e.g., a stream or well) used for cooking or drinking. The garbage burial area should be at least 30 yd from dining facilities to minimize problems with flies, odor, and appearance. In camps of less than one-week duration, the kitchen wastes are disposed of by burial in pits or trenches (fig. 2–17). Pits are preferred for overnight halts. They are usually dug 4 ft square and 4 ft deep. The pit is filled to not more than 1 ft from the top; then it is covered, compacted, and mounded with 1 ft of earth.

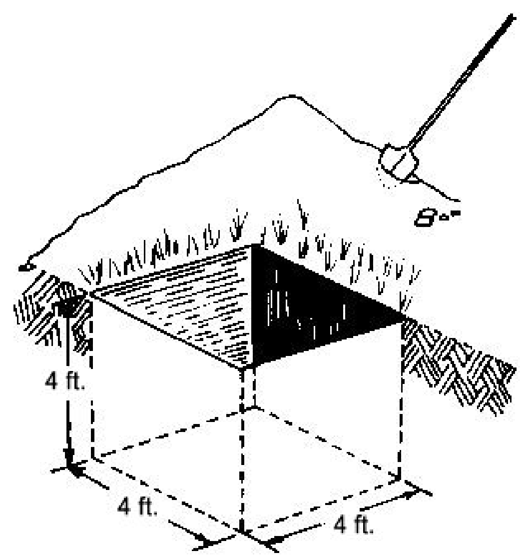


Figure 2–17. Garbage burial pit.

The continuous trench is more adaptable to stays of two days or more. This method is started by digging a trench about 2 ft wide, 4 ft deep, and long enough to accommodate the garbage. As in the pit method, the trench is filled to not more than 1 ft from the top. The trench is extended as required, and the excavated dirt is used to cover and mound the first deposit. This procedure is repeated daily or as often as garbage is dumped. It is a very efficient field expedient method for disposing of garbage.

Incineration

In temporary camps of one week or more, the garbage is often burned in open incinerators. Excellent types of open incinerators may be constructed from materials that are readily available in any camp area. Since incinerators will not handle wet garbage, it is necessary to separate the solid from the liquid portions of the garbage. This is done by straining the garbage with a coarse strainer such as an old bucket, salvage can, or oil drum with holes punched in the bottom. The solids remaining in the strainer are incinerated, and the liquids are poured through a grease trap into a soakage pit. Since field incinerators create an odor nuisance, they should be located at least 50 yd downwind from the camp.

Cross trench and stack incinerator

The cross trench and stack incinerator (fig. 2–18) will effectively take care of the waste produced by a medium-size unit. This is an excellent dry trash incinerator, but wet material tends to disrupt the draft, which makes burning difficult. Two trenches, each 10 ft long, are constructed so that they cross at right angles. The trenches slope from the surface of the ground at the ends to a depth of 18 in at the intersection. A grate is made from pieces of scrap iron laid over the intersection of the trenches. A stack is made from an oil drum with both ends cut out, or with one end cut out and the other end liberally punched with holes to admit draft air. A fire is built on top of the grates and the waste is added, one shovelfull at a time, on top of the fire.

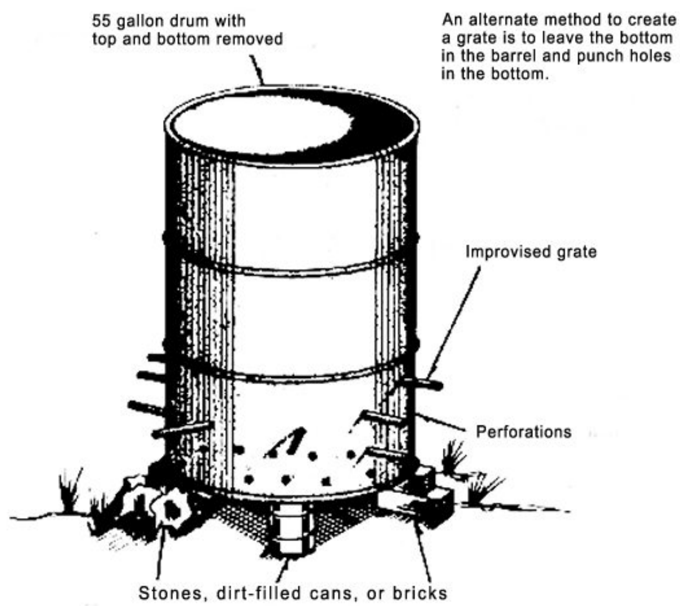


Figure 2–18. Cross trench and stack incinerator.

Inclined plane incinerator

The inclined plane incinerator (fig. 2–19) will dispose of the garbage of larger units. Its effectiveness, and the fact that it is not affected by rain or wind, makes it an excellent improvised device. Time and skill, however, are required in building it. A sheet metal plane is inserted through telescoped oil drums from which the ends have been removed. A loading or stoking platform is built; then one end of the plane-drum device is fastened to it, creating an inclined plane. A grate is positioned at the lower end of the plane, and a wood or fuel oil fire is built under the grate. After the incinerator becomes hot, drained garbage is placed on the stoking platform. As the garbage dries, it is pushed down the incline in small amounts to burn. Final combustion takes place on the grate.

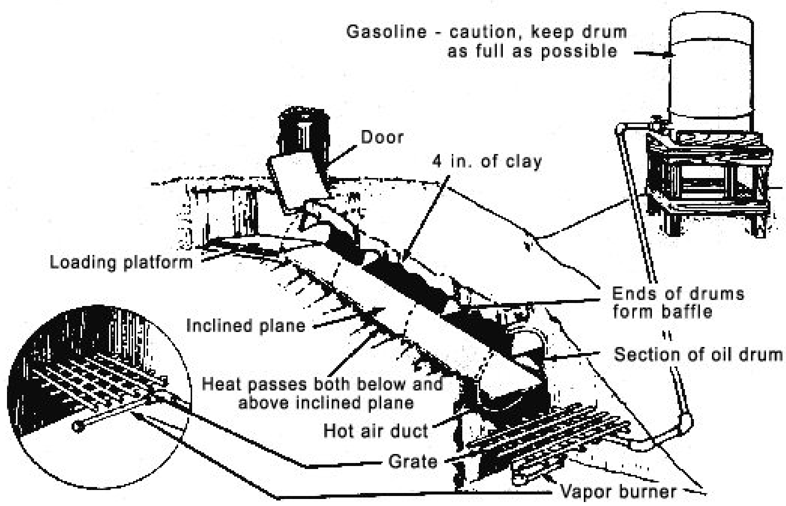


Figure 2–19. Inclined plane incinerator.

Liquid waste disposal

Liquid waste includes wash and bath water and liquid kitchen wastes. It is usually disposed of in the soil by soakage pits or trenches. Grease, soap, and other solid particles inhibit the soil's absorption of the liquids and must be removed. For this reason, a grease trap is made as a part of each soakage pit or trench used for wash and kitchen waste disposal. Evaporation beds may be used where soil conditions prevent the use of soakage pits or trenches. Liquid kitchen wastes accumulate at the rate of 1 to 5 gal per person, per day. It is imperative they are disposed of properly. Let's study some methods of getting rid of these wastes.

Soakage pits

Liquid wastes are disposed of in the soil by soakage pits (fig. 2–20) at or near the place where they are produced. A soakage pit for the disposal of kitchen wastes is constructed in the same manner as the soakage pit for urine disposal, except it is equipped with a grease trap. Two pits are needed for a medium size unit so that each one can have a rest period every other day. In porous soil, a soakage pit 4 ft square and 4 ft deep will take care of 200 gal of liquid per day. In camps of long duration, each soakage pit should be given a rest period of one week every month. Even though precautionary measures are taken, a pit may become clogged with organic material.

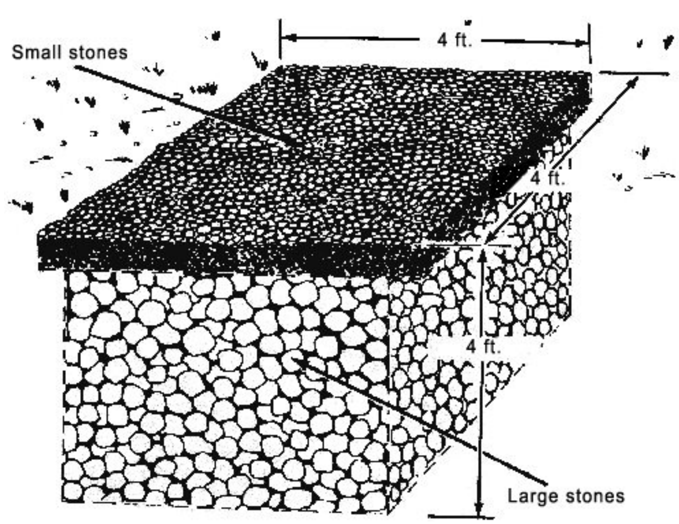


Figure 2–20. Soakage pit.

Soakage trenches

If the ground water table is high or a rock stratum is encountered near the surface, soakage trenches (fig. 2–21) may be substituted for soakage pits. These trenches are extended outward from each corner of a central pit dug 2 ft square and 1 ft deep. The trenches are dug 1 ft wide and 6 or more ft long. The depth is increased from 1 ft at the end joining the pit to 18 in at the outer end. The pit and the trenches are filled with rock, flattened cans, broken bottles, or other coarse contact material. Two such units should be built for every 200 persons fed, and each unit should be used on alternate days. A grease trap is used with this device.

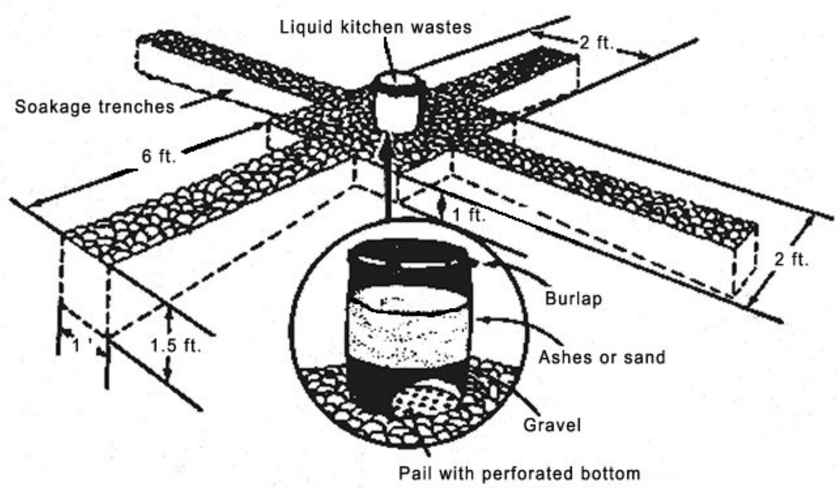


Figure 2–21. Soakage trench.

Evaporation beds

In a hot, dry climate where heavy clay soil prevents the use of standard soakage pits, evaporation beds (fig. 2–22) may be required. These beds actually involve the processes of evaporation, percolation, and oxidation. Sufficient beds, 8 × 10 ft, are constructed to allow 3 square ft per person, per day for kitchen waste and 2 square ft per person, per day for bath waste. The beds are spaced so that the wastes can be distributed to any one of the beds. The beds are constructed by scraping off the topsoil and constructing small dikes around the 8 × 10 ft spaces. These spaces are then spaded to a depth of 10–15 in, and the surfaces are raked into a series of ridges and depressions, with the ridges approximately 6 in above the depressions. These rows may be built either lengthwise or crosswise for the best distribution of water. In operation, beds are flooded at different intervals. On a certain day, one bed is flooded to the top of the ridges with liquid waste. This condition is equivalent to an average depth over the bed of 3 in, and liquid waste is allowed to evaporate and percolate. After about four days this bed is usually sufficiently dry for respading and reforming. The other beds are flooded on successive days, and the same sequence of events is followed. Careful attention must be given to proper rotation, maintenance, and dosage. It is also essential that the kitchen waste run through an efficient grease trap before it is allowed to enter the evaporation beds. If these beds are used properly, they create no insect hazard and only a slight odor.

Grease traps

The grease trap is a necessary addition to the kitchen soakage pit and trenches. All kitchen liquids are passed through a grease trap to remove food particles and as much grease as possible. If traps were not used, the soakage pits become clogged and useless. There are two types of grease traps—the filter and the baffle.

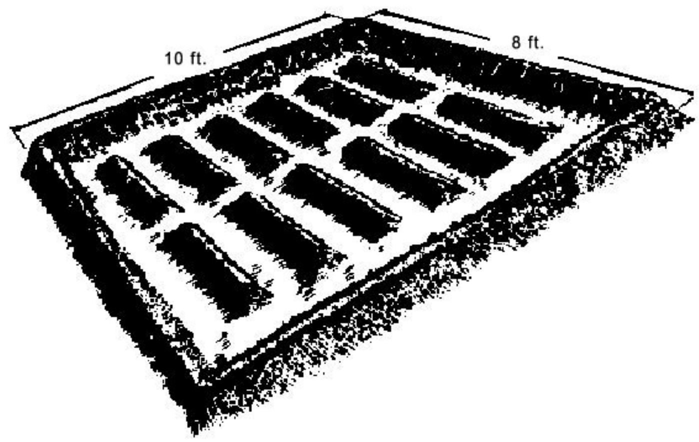


Figure 2–22. Evaporation bed.

Filter grease trap

The filter grease trap (fig. 2–23) is built using an oil drum. The drum, with the top removed and the bottom perforated, is filled two-thirds full with crushed rock or large gravel at the bottom. This is followed by smaller size gravel and then a 6 in layer of sand, ashes, charcoal, or straw. The top of the drum is covered with burlap or other fabric to strain out the larger pieces of debris. The barrel is usually placed in the center of the soakage pit with the bottom of the barrel about 2 in below the pit surface. The burlap or other fabric is removed daily, burned or buried, and replaced with a clean piece of fabric. The 6 in layer of filtering material is removed, buried, and replaced once or twice weekly.

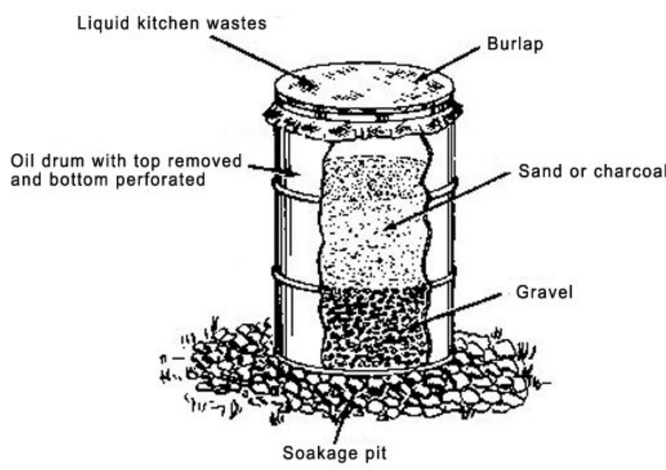


Figure 2–23. Baffle grease trap.

Baffle grease trap

The baffle grease trap (fig. 2–24) is the most effective way of removing grease. It is a watertight container divided into entrance and exit chambers by a baffle. The entrance chamber has about twice the capacity as the exit chamber. The lower edge of the baffle hangs within 1 in of the bottom. The outlet, a 2 in pipe, is placed from 3 to 6 in below the upper edge of the exit chamber. The baffle grease trap is usually placed on the ground at the side of the soakage pit with the outlet pipe extending 1 ft beneath the surface at the center of the pit. The liquid waste is strained of solids and debris before it goes into the entrance chamber of the trap. The strainer is filled two-thirds full with loose straw, hay, or grass. Before the grease trap is used, the chambers are filled with cool water.

When the warm liquid strikes the cool water in the entrance chamber, the grease rises to the surface and is prevented by the baffle from reaching the outlet to the soakage pit. If the water is warm, proper separation of the grease will not occur. (This often happens in hot climates.) The grease retained in the entrance chamber is skimmed from the surface of the water daily, or more frequently as required, and buried. The trap should be emptied and thoroughly scrubbed with hot, soapy water as often as necessary. The efficiency of this grease trap can be increased by constructing it with multiple baffles. You may also use a series of baffle grease traps.

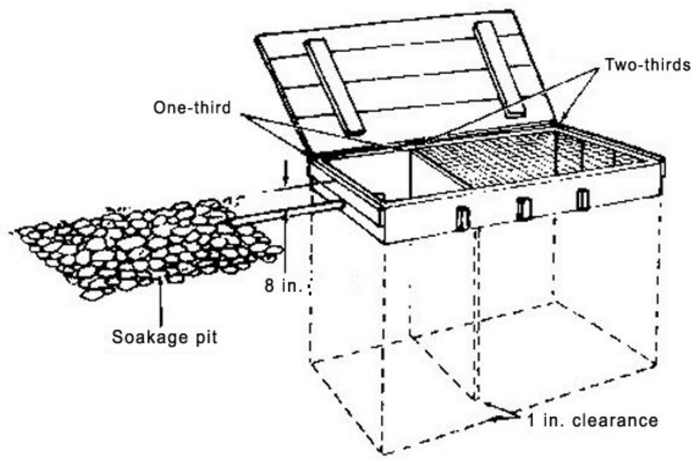


Figure 2–24. Filter grease trap.

Medical waste

Under field conditions, medical waste should be given the same precautions as medical waste generated during peacetime. The major difference between peacetime and wartime is that a unit's access to services for the removal of medical waste may be limited or nonexistent. If units have resources available for the removal of medical waste (i.e., contractors specifically hired to handle medical waste), these resources are the preferred method of removal to ensure proper handling and disposal. Units without contractor support should dispose of medical waste either by burial or incineration. In either case, the medical waste should remain in Sharps containers while handling to prevent exposure to bloodborne pathogens.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

814. Human waste disposal in field conditions

1. What are the basic sanitary requirements for latrines?

2. How many latrines are required for males and females?

3. What is a "cat-hole"?

4. What are the different types of latrines?

5. Where should urinal pipes and urinal troughs drain?

815. Garbage and medical waste disposal in filed condition

1. What are the methods for garbage disposal?

2. What are three ways to dispose of liquid waste?

3. What is the purpose of a grease trap?

2–4. Prevention of Heat and Cold Stress Injuries

Human body temperature is regulated within extremely narrow limits, even though there may be marked variations in the environmental temperature. Exposure to high or low environmental temperature produces stress on the body that may lead to a heat or cold injury.

816. Heat injuries

Three distinct clinical syndromes of heat injury may occur, depending on the manner of breakdown in the individual's heat adjustment. These injuries are heat cramps, heat exhaustion, and heatstroke. The three conditions produce distinctive signs and symptoms, which should be recognized at once not only by a medical officer, but also by other personnel if the casualty is to receive proper care and attention. All military personnel must be familiar with the preventive measures for these conditions.

Heat equilibrium factors

The conditions which influence the heat equilibrium of the body and its adjustments are the air temperature, the temperature of the surrounding objects, the sun's radiant heat, the vapor pressure of the water in the air (relative humidity), the air movement, and the amount and type of clothing worn. Another important factor that influences the heat equilibrium is the metabolic heat produced by the body as a result of physical activity. The environment also plays a part in body heat loss. There are four environmental factors that influence heat equilibrium:

1. The rate and direction of heat flow from (or to) the body depends on the temperature of the environment. When the environmental temperature is much below body temperature the rate of heat loss is high. This rate falls as the environmental temperature reaches body temperature and stops when these temperatures are equal. As the environmental temperature rises above body temperature, the body's primary method of getting rid of excess heat is by sweating.
2. The wind is another important factor in heat regulation. As the wind rate increases, the warm air, cooled by the body through conduction, is blown away and replaced by additional warm air that increases body heat. If the air is warmer than the skin, it may still help cool the body

by evaporating sweat. With a high-wind rate, the skin may be injured by mechanical forces (windburn) that may decrease body heat loss.

3. Air humidity is yet another important heat loss factor. The air, at any given temperature, can hold only a certain amount of water vapor. As the environmental humidity (the measurement of how much water vapor there is in the air) rises, smaller amounts of sweat can evaporate, and heat loss by evaporation slows. This is the main difference between the heat of the desert (low humidity) and the jungle (high humidity). Because of the limitation of evaporation, heat injuries occur at lower environmental temperatures in the jungle or in any area where the humidity is high. For sweating to be effective, it must evaporate from the skin surface. Sweat that drips or is wiped off does not aid in body heat loss.
4. Radiant energy is also an important environmental factor. If objects, such as runways, surrounding a human body are hotter than the body, they will radiate heat to the body. In warm weather, and especially outdoors in the sun, the radiant heat load is high, and the body cannot lose heat by radiation. Shade and light colored clothing block absorption of the radiant energy of the sun by the body.

Types of heat injuries

Heat cramps

Painful cramps of the voluntary muscles may occur following exposure to heat. Heat cramps result primarily from excessive loss of salt from the body. The muscles of the extremities and of the abdominal wall are usually involved, and the cramps may be of great severity. Heat cramps can occur alone or in the presence of heat exhaustion. Body temperature is normal unless heat cramps are accompanied by heat exhaustion.

Heat exhaustion

Heat exhaustion occurs as the result of peripheral vascular collapse due to excessive salt depletion and dehydration. This syndrome is characterized by:

1. Profuse sweating, headache, tingling sensations in the extremities, pallor (unusual or extreme paleness), dyspnea (difficult or labored breathing), palpitations associated with gastrointestinal symptoms of anorexia and occasionally nausea and vomiting.
2. Neuro-muscular disturbances with trembling, weakness, and uncoordination coupled with cerebral signs ranging from light clouding of the head to momentary loss of consciousness complete the classical picture.
3. The skin is cool and moist.
4. The pulse rate is rapid (120 to 200 beats per minute), and the blood pressure may be low.
5. The oral temperature may be subnormal (e.g., in cases where hyperventilation is present) or slightly elevated; however, the rectal temperature is usually elevated.

Heatstroke

HEATSTROKE IS A MEDICAL EMERGENCY, with a high death rate. Heat exhaustion may be regarded as the end result of overactive heat-balance mechanisms that are still functioning, but heatstroke results when thermo-regulatory mechanisms are not functional, and the main avenue of heat loss (cooling by evaporation of sweat) is blocked.

There may be early signs (e.g., headache, dizziness, delirium, weakness, nausea, vomiting, and excessive warmth); however, sweating may or may not be absent. Although the casualty may first progress through the symptoms of heat cramps or heat exhaustion, the onset of heatstroke may occur with dramatic suddenness through collapse and loss of consciousness. Profound coma is usually present and convulsions may occur. In the early stage, the casualty’s skin is usually hot, red, and dry. The presence of sweating does not exclude this diagnosis. The best sign of this injury is a high body temperature—in excess of 106°F. A rectal temperature exceeding 108°F is not uncommon and indicates a poor prognosis. The casualty's condition deteriorates rapidly; therefore, treatment must begin immediately. One attack of heatstroke predisposes an individual to a second attack, and care should be taken by the individual to avoid a second exposure to the precipitating condition.

Predisposing factors leading to heat injury

Several human factors come into play which increase the heat load on the body and make the likelihood of injury more prevalent:

1. Individuals who are unacclimatized are much more likely to be injured. Recruits are particularly vulnerable to heat injury. The individual who has been living in a cool climate does not handle heat stress well. In fact, a person who is acclimatized to heat and who moves to a cool area for one month loses most of his acclimatization to heat.
2. Overweight and fatigue impair the body's heat-losing mechanisms. It takes work on the part of the body to lose heat, and an already tired body cannot perform this function well.
3. Heavy meals and hot foods put unnecessary stress on the body. Hot meals add heat, which must be eliminated. Heavy meals direct blood flow to the digestive tract.
4. Use of alcoholic beverages, especially amounts resulting in hangovers, will decrease the ability of the body to deal effectively with heat stress.
5. Fever increases the amount of heat to be dissipated by the body. Fever is usually the result of disease processes, but can also be induced by man. Many of the immunizations that are administered produce fevers.
6. Drugs that inhibit sweating (e.g., atropine, antihistamines, some tranquilizers, cold medicines, and some antidiarrheal medications) markedly impair heat loss when temperatures are high.
7. Tight clothing is detrimental to heat loss from the body. Clothing should be loose so it does not restrict circulation or impede movement of air over the skin.

Prevention of heat injuries

Successful prevention of adverse effects of heat depends largely on education of personnel (i.e., personnel exposed to heat and those charged with the supervision of such personnel). Specifically, preventing heat injury involves developing procedures that alert individuals to the existence of dangerous heat stress levels, applying measures to reduce both the severity and duration of exposure, and adopting techniques to increase the resistance of exposed persons. The seven major ways to protect individuals from heat injuries are:

1. Water.
2. Salt.
3. Acclimatization.
4. Physical condition.
5. Work schedules.
6. Protection from the environment.
7. Education.

Water

The human body is highly dependent on water to cool itself in a hot environment. By sweating, an individual may lose water in excess of one quart per hour. These losses must be replaced or a rapid decrease in the ability to work, a rise in body temperature and heart rate, deterioration of morale, and heat injury will occur. Water loss should be replaced by frequent intake of small amounts of water throughout the work period. Personnel must be encouraged and given the time to drink water because a person's normal thirst does not serve as a true indication of the body's need for water. The following table may be used as a guide to estimate the drinking requirements for personnel exposed to heat. It should be used for planning and procurement purposes only and should not be used as a yardstick for water intake of any individual.

Criteria*		Controls		
		Physical Activity for Personnel		
Heat Condition/Category	WBGT Index ^{0}F	Water Intake Quart/Hour	Acclimatized Work/Rest**	Unacclimatized
1	78–81.9	At least 1/2	Continuous	Use discretion in planning heavy exercises.
2	82–84.9	At least 1/2	50/10 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.
3	85–87.9	At least 1	45/15 minutes	Curtail strenuous exercise for all personnel with less than 12 weeks of hot weather training.
4	88–89.9	At least 1 1/2	30/30 minutes	Physical training and strenuous exercise is suspended. Essential operational commitments not for training, where risk of heat casualties may be warranted, is excluded from suspension. Enforce water intake to minimize expected heat injuries.
5	90 and up	More than 2	20/40 minutes	

* MOPP gear or body armor adds 10^0 to the wet bulb globe temperature (WBGT) index.

**An acclimatized person 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 (e.g., training by lecture or demonstration, minor maintenance procedures on vehicles or weapons, personal hygiene activities, such as skin and foot care).

During periods of moderate activity, with moderate conditions prevailing, water requirements will be one pint or more per hour per person. This is best taken at 20- to 30-minute intervals. As activities or conditions become more severe, the intake increases accordingly. When water is in short supply, significant water economy may be achieved by limiting physical activity to the early morning, late evening, and night hours when the heat load is less and sweating is reduced. The optimum drinking water temperature is between 50°F and 60°F. The belief that people can be taught (toughened up) to adjust to decreased water intake is incorrect. Man cannot live or work in heat without sufficient water.

Salt

In addition to water, sodium chloride is lost in sweat. The military diet (MREs or T-rats) usually provides adequate salt. A convenient method of providing adequate salt intake is to encourage the use of salt added at mealtime. This, along with salt in cooking and in bread, will meet most requirements. Excess intake of salt should be avoided because it may cause increased thirst and intestinal disturbances. Normally, additional salt requirements are added at the discretion of a medical provider or physician.

Acclimatization

Training programs for personnel who are climatically and/or physically unseasoned to heat should be limited in intensity and time. A period of approximately two weeks should be allowed for acclimatization with progressive degrees of heat exposure and physical exertion. If personnel are required to perform heavy physical work before being acclimatized, the work is poorly performed, development of the capacity to effective work is retarded, and the risk of heat injury and disability is high. A period of acclimatization (10 to 14 days) is necessary regardless of the individual's physical condition. However, the better the physical condition, the quicker acclimatization is completed. Remember, adequate water must be provided at all times. Personnel cannot learn to do without water.

Physical condition

The general physical condition of the individual has a significant bearing on the reaction to heat stress. Individual susceptibility to heat may be enhanced by a large number and variety of conditions (e.g., infections, fevers, immunization reactions, heat rash, sunburn, fatigue, overweight, and previous case of heatstroke). People who are not physically fit and are overweight have a much higher risk of heat injury than people whose weight is normal. Special care should be exercised when high-risk people are exposed to high temperatures. An individual once affected should, therefore, be exposed to heat stress with caution. Predisposition is not developed in the case of heat exhaustion and heat cramps.

Work schedules

Work schedules must be tailored to fit the climate, the physical condition of personnel, and the military situation. Close supervision by medical personnel and commanders is essential in achieving maximum work output with minimum hazard. Several principles must be considered:

1. The amount of heat produced by the body increases directly with increasing work; therefore, reduction of workload markedly decreases the total heat stress.
2. Workloads and/or duration of physical exertion should be less during the first days of exposure to heat and should be gradually increased to allow for acclimatization.
3. Decisions to modify work schedules must be governed by the local situation, but heavy work should be scheduled for the cooler hours of the day such as early morning or late evening.
4. Alternate work and rest periods may prove desirable. Under moderately hot conditions, five-minute rest periods in the shade alternating with 25 minutes of work in the sun may be desirable. Under severe conditions, the length of rest periods should be increased.
5. Exposure to high temperatures at night, as well as in the daytime, will decrease the amount of work that can be performed effectively.
6. Workloads must be reduced at high temperatures when dehydration, resulting from excess sweating and lack of water replacement, occurs. When water is in short supply, working in the early morning and late evening, when the temperatures are lower, will allow for more work to be accomplished with less water expended.
7. Work in the direct sun should be avoided as much as possible on hot days.
8. Unnecessary standing at attention in the heat should be avoided because continued standing places an added burden on the body's circulatory system.
9. When the temperature is very high, physical work should be curtailed or, under extremely severe conditions, even suspended. The temperature which work should be curtailed or suspended depends on the humidity, heat radiation, air movement, character of the work, degree of acclimatization of personnel, and other factors. Heat casualties may be expected at WBGT indices of 75°F and above unless preventive measures are instituted. Overexertion can cause heat injury at even lower temperatures, especially if body armor or vapor impermeable protective clothing is worn.

Protection from the environment

Except when exposed to the sun's rays, an individual in a hot environment is better off wearing the least allowable amount of clothing. Clothing reduces the exposure of the body surface to solar radiation, but at the same time decreases the movement of air over the skin. To take full advantage of its benefits and minimize its disadvantages, clothing should be loose fitting—especially at the neck, wrists, waist, and lower legs—to allow air circulation. Protection from the environment also includes such simple, but frequently overlooked, things as marching troops over grass rather than concrete and operating in the shade.

Education

Prevention of heat casualties depends largely on the education of personnel, and especially upon supervision by informed leaders. Every individual exposed to high temperatures should be informed of the potentially serious results of heat injury, the general nature of these conditions, and how they can be prevented. Supervisors must be able to identify environmental conditions under which adverse heat effects are likely to occur. They should recognize the earliest signs of heat injury and take action to prevent the development of cases. All personnel should be able to apply effective first aid. Mental confusion and overactivity usually precede collapse from heatstroke. Supervisors must be alert to detect this condition, enforce rest, and get medical assistance promptly. Medical personnel should assist commanders in the development of local programs for heat injury prevention.

817. Cold injuries

Cold injury is defined as tissue injury produced by exposure to cold. The type of injury produced depends upon the degree of cold to which the body is exposed, the duration of the exposure, and the environmental factors responsible for injuring the body.

Types of cold injuries

Cold injuries can occur at nonfreezing and at freezing temperatures. Pathologically, all cold injuries are similar. Nonfreezing cold injury is associated with exposure to water and cold. Chilblain, immersion foot, and trench foot are three common terms applied to nonfreezing cold injuries. Frostbite is an injury caused by freezing cold, and hypothermia is a condition caused by cold and body heat loss. The following table outlines the five common types of cold injuries:

Injury	Definition
Chilblain	Chilblain is an inflammation followed by itchy irritation on the hands, feet, or ears. It results from intermittent exposure to temperatures above freezing, in high humidity (moist cold).
Immersion foot	Immersion foot results from prolonged exposure, usually in excess of 12 hours, in water at temperatures usually below 50°F. It is not limited to the feet, but may involve other areas of the body following immersion. Exposure for several days in water at 70°F in tropical latitudes has produced severe injury.
Trench foot	Trench foot results from prolonged exposure to cold, and usually wetness, at temperatures from just above freezing to 50°F. It is often associated with immobilization and dependency of the lower extremities. The average duration of exposure resulting in trench foot is three days.
Frostbite	Frostbite (frozen tissue) is produced by exposure at temperatures of freezing or below. Depending upon the air temperature, the time of exposure varies from a few minutes to several hours. High altitude frostbite results from exposure at high altitudes to temperatures varying from –20°F to –80°F. At these very low temperatures, severe injury may be instantaneous, especially to exposed parts such as fingers, ears, and the nose.
Hypothermia	General hypothermia is an acute problem resulting from prolonged cold exposure and loss of body heat. If an individual becomes fatigued during physical activity, he/she will be more prone to heat loss, and as exhaustion approaches, sudden blood vessel dilation occurs with resultant rapid loss of body heat.

Predisposing factors

Cold injury, as it involves a military population, generally behaves according to accepted epidemiological principles. A specific agent is present and a variety of environmental and host factors influence the incidence, prevalence, type, and severity of the injury. The main factors involved in cold injury are:

- Agent factors.
- Environmental factors.
- Host factors.

Agent factors

Cold is the specific agent in cold injury and is the immediate cause of tissue damage without respect to the influence of modifying factors. If the effect of cold is considered in terms of body heat loss, the effect of moisture as a conductor of heat is readily apparent. Also, various host and environmental factors have an effect on the severity of cold injury. Therefore, the effect of cold cannot be evaluated in direct relation to air temperature alone.

Environmental factors

Weather is a predominant factor in cold injury. Temperature, humidity, precipitation, and wind modify the rate of body heat loss. Low temperatures and low relative humidity favor development of frostbite. Higher temperatures (i.e., just above freezing up to 50°F), together with moisture, are usually associated with trench foot. Wind velocity accelerates body heat loss under conditions of both coldness and wetness. The effect of low temperatures is intensified as air movement passing the body increases. This can be the result of wind against the body or the effect of a body moving rapidly through the air, such as in running, skiing, or riding in an open vehicle.

The incidence of cold injury varies greatly according to the type of activity. Units in rest areas have relatively few cases of cold injury. During holding missions or static defense, the exposure is greater, and a moderate increase in incidence is expected. Marked increases in cold injuries usually occur during active defense or offense. Immobility under fire; prolonged exposure; lack of an opportunity to get warm, change clothing, or carry out personal hygienic measures; fatigue; and a lack of nutrition may have an effect on the intensity of injury.

Host factors

Host factors that are predisposed to cold injuries and their descriptions are covered in the following chart:

Host Factor	Description
Age	Within the usual age range of military personnel, age is not significant.
Rank	Trench foot and frostbite injuries are higher in front-line personnel, and predominantly in those of lower ranks because they have greater exposure. The decreased incidence of cold injury among higher rank personnel is due to a combination of factors— experience, leadership, training, and significantly less exposure.
Previous cold injury	A previous episode of trench foot, frostbite, or immersion foot greatly increases the individual's risk of another cold injury to the same area.
Fatigue	Contributes to cold injury because as personnel become exhausted they fail to carry out simple preventive measures. This occurs more frequently in personnel who have been in combat for 30 days or more without rest. Mental weariness may cause apathy leading to the neglect of needs vital to survival. Frequent rotation of personnel for even short periods lessens the effects of fatigue.

Host Factor	Description
Discipline, training, and experience	Individual and unit discipline, training, and experience are closely related as they influence the incidence of cold injury. Well-trained and well-disciplined personnel profit from experiences in the cold. They are better able to care for themselves through personal hygiene, care of the feet, change of clothing, and exercise of the extremities. Preventive measures necessary for survival in the cold must be continuously stressed to the troops, enabling them to cope with these problems.
Psychological factors	Cold injury tends to occur in passive, negativistic, or hypochondriacal individuals, who display little muscular activity. These people are prone to pay less attention to carrying extra footwear, changing socks when needed, and reducing smoking under combat conditions where cold injury is a threat.
Race	In terms of numbers at risk, and independent of geographic origin, African Americans appear to be considerably more vulnerable to frostbite than are Caucasians.
Geographic origin	This seems to be a significant factor among Caucasians in the incidence of cold injury. Origin from warmer climates of the United States (including Puerto Rico) (where the mean minimum January temperature is above 20°F) predisposes cold injury.
Nutrition	Poor nutrition contributes to susceptibility to cold injury. Adequately clothed and protected personnel living and working in cold climates do not require an increase in caloric intake above that normally provided in the military ration. Individuals who do not eat regularly, or do not eat complete, balanced meals are more susceptible to injury.
Activity	Too much or too little activity can contribute to cold injury. Overactivity with rapid and deep breathing can cause large amounts of body heat loss. Perspiration trapped in clothing markedly reduces the insulating quality of the clothing. On the other hand, immobility causes decreased heat production with the danger of resultant cooling, especially of the extremities.
Drugs and Medications	Personnel should be made aware of the effects of smoking in decreasing peripheral circulation and of alcohol ingestion in dilating peripheral vessels. Persons on peripheral vasodilator (medications that relax or widen blood vessels) medications may be at added risk of cold injury due to reduced circulation. Both tobacco and alcohol should be avoided when the danger of cold injury exists.

Prevention of cold injuries

Cold injuries are preventable except in unusual situations. Successful prevention requires vigorous command leadership, prior planning (e.g., cold weather training), cold weather clothing and equipment, and education. Specific countermeasures are directed toward conserving body heat and avoiding unnecessary exposure of personnel to cold, moisture, and activities of factors favoring cold injury. Personnel must be educated on countermeasures to prevent cold injuries in the field.

Protective clothing

Guidelines to follow when selecting protective clothing are:

- Wear or carry adequate amounts of the proper types of clothing for the weather to be encountered.
- Wear clothing in layers so excess layers can be removed before sweating causes the material to lose its insulating properties. Outer layers should be wind-resistant.
- Loose clothing allows for efficient blood circulation and creates air pockets, which provide insulation.
- The clothing must be clean and dry.

- The rain suit (gear) must be large enough to fit over the cold weather clothing. All exposed skin areas need protection from the cold and wind.
- The face is especially vulnerable to cold injury and as much as 75 percent of body heat loss is through the head, so these areas should be covered with protective clothing.

Heat injuries may occur in cold weather operations, so wearing the clothing as stated above can prevent such an occurrence.

Care of the feet

The feet must be given special attention. Cold weather, insulated, rubber boots (black or white) will be issued to troops during cold weather operations. Frequent changes of socks are important with these boots because of increased sweating, retention of sweat, and a lowered resistance to fungal infections. Sweat in these boots can lead to softening of the soles of the feet that can result in skin loss, infection, and hospitalization. Cold injuries can still occur in these boots if the feet are not exercised. In any boot, the feet are more prone to sweating than other parts of the body. Moisture in the socks will reduce their insulating quality; making frequent sock changes a must. Wet socks can be dried by placing them unfolded inside the shirt. Extra socks must be carried at all times and dirty socks washed whenever possible.

Protection of the hands

Mittens are more protection than gloves, and individuals should keep a dry pair for use whenever possible. Gloves present more surface area for heat loss and are therefore less efficient than mittens in keeping hands and fingers warm. When wet, leather gloves must be dried slowly to prevent shrinking and hardening of the leather. The wool liners must be dried slowly to prevent shrinking.

Exercise

Avoid immobilization. Exercise of large muscle groups will generate internal body heat. Wiggling the fingers and toes will increase circulation and keep them warm. Massage the ears and nose periodically for the same reason. When exercise is not possible, frequent changes of position will encourage circulation.

Diet

Increased caloric intake, especially in the form of carbohydrates, is important for the production of internal body heat. Proper diet includes hydration. Adequate water intake is as important in cold environments as in hot. Personnel, bundled up in layers of protective clothing, may not be aware of the amount of sweat they are losing. Water discipline must be enforced in cold environments.

The buddy system

Personnel must be trained to recognize signs of cold injuries on other individuals. When blanching of the skin is noted, immediate action will usually prevent the development of cold injury. Holding (not rubbing) a warm hand on the blanched area until it returns to a normal color is an effective treatment for a cold ear, nose, or cheek. Fingers can be warmed against the bare abdomen, chest, or armpit. If the casualty complains of an abrupt loss of cold sensation or extreme discomfort in the affected body part, immediate action must be taken; as these are classic early warning signs of frostbite.

Sunglasses/sunscreen

When working in snow conditions, use of sunscreen and sunglasses is strongly recommended. Sunglasses must be worn during daylight hours regardless of whether the sun is shining brightly or not. A bright, cloudy day is deceptive and can be as dangerous to the eyes and skin as a day of brilliant sunshine. The glasses will also protect against blowing snow. The risk of snow blindness and sunburn is increased at high altitudes because the clear air allows more of the burning rays of sunlight to penetrate the atmosphere.

Education

The bottom line is public health must educate all troops deploying to a cold climate to prevent cold injuries. Public health must educate, but commanders and line supervisors must ensure personnel are following the countermeasures listed above. Cold injuries can be prevented!!

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

816. Heat stress injuries

1. What are the three clinical syndromes of heat injury?

2. What is the cause and what are the symptoms of heat cramps?

3. What are the common symptoms of heat exhaustion?

4. What are the significant differences between heat exhaustion and heat stroke?

5. What are the human factors that make the likelihood of heat injury more prevalent?

6. What are the ways to prevent heat injuries?

7. What is the best method of providing an adequate salt intake?

8. The successful prevention of adverse effects of heat depends largely on the education of which two groups of people?

9. What period of time should be allowed for acclimatization?

10. When should strenuous physical activity or work be scheduled?

817. Cold injuries

1. What are the five cold injuries discussed.

2. What causes trench foot and immersion foot?

3. What causes hypothermia?

4. What three main factors are involved in cold injury?

5. What is the predominant factor in cold injury?

6. Why is rank a factor in cold injuries?

7. Why should personnel avoid alcoholic beverages during extremely cold weather?

8. How should clothing be worn in cold weather?

Answers to Self-Test Questions

808

1. Diarrheal, respiratory, skin, and vectorborne.
2. Immunizations, living areas with adequate space and ventilation, head-to-foot sleeping arrangements, and frequent handwashing to reduce droplet and aerosol spread of respiratory diseases.
3. Breakdown in personal hygiene and sanitation.
4. Research and be able to recognize the hazardous species indigenous to the area of operations.
5. Proper handwashing, practicing good oral hygiene, showering, and foot care.

809

1. Site selection, site set-up, disease surveillance, disease prevention, and training for deployed personnel.
2. Eat only foods served to you piping hot, (2) avoid dairy products; some countries do not pasteurize their dairy products, (3) eat only fruits and vegetables that can be peeled, by peeling you can remove any contamination, (4) do not eat food from streetside vendors, (5) drink only bottled water or carbonated beverages from approved sources, (6) do not drink local water or consume ice.
3. Security police, civil engineering, dining hall, maintenance organizations, and medical teams.
4. OIC or NCOIC, public health.

810

1. To protect the foods from the sun, dirt, insects, rodents, and other sources of contamination.
2. (1) Store foods in clean, covered containers, (2) store containers at least 6 in from the floor/ground, (3) do not use galvanized containers for acidified foods, (4) store foods out of direct sunlight, and (5) facilities should be insect/rodent proof.
3. In accordance with the food code.
4. The ice should be potable.
5. In clean, sealable containers and protected from excessive heat and moisture.

811

1. In protected areas.
2. To reduce insect and rodent feeding and breeding places.
3. The food code.
4. To detect signs of illness or evidence of infection.
5. Personnel with skin infections, boils, diarrhea, or any evidence of infection or illness.
6. After each use.
7. Immersing in boiling water for 30 seconds, or immersing in a chlorine water solution for at least one minute.
8. (1) To ensure basic standards are maintained, (2) to identify potential problems that could result in a foodborne illness outbreak, (3) to recommend ways to correct problems, and (4) to provide an opportunity to educate food service personnel.

812

1. Existing public water supply, surface water, ground water, and bottle water.
2. Surface water, because it is generally the most accessible.
3. Sodium hypochorite (liquid bleach) and calcium hypochlorite powder.
4. 60 minutes.
5. Iodine tablets (canteens for personal use), Chlor-Floc water treatment kit and boiling.
6. There is no residual protection against recontamination.

813

1. 1 ppm (FAC) or other level established for the area of operation.
2. Every 30 minutes of the operating day.

814

1. Built at least 100 yd from food facilities and unit ground water sources; (2) not dug to ground water level; (3) built at least 30 yd from the border of unit area, but within reasonable distance for easy access; and (4) have a drainage ditch dug around the edges of it.
2. Enough to service 4 percent of the male and 6 percent of the female population.
3. A latrine that is a hole, approximately 1 ft deep, covered and packed down with dirt after use, which is used for short stays for an individual's use.
4. Cat-hole, straddle trench, deep pit, burn-out, mound, pail, and chemical latrines.
5. Into a soakage pit, deep pit latrine, or a chemical latrine.

815

P1. Burial or incineration.

2. Soakage pit, soakage trench, and evaporation beds.
3. To remove grease and other food particles from liquid wastes.

816

1. Heat cramps, heat exhaustion, and heat stroke.
2. Excessive salt loss; muscle cramps of the extremities and abdominal wall.
3. Profuse sweating, headache, tingling sensations in the extremities, pallor, dyspnea, palpitations associated with gastrointestinal symptoms of anorexia, and occasionally, nausea and vomiting. Neuro-muscular disturbances with trembling, weakness, and uncoordination coupled with cerebral signs ranging from light clouding of the head to momentary loss of consciousness. Cool, moist skin, rapid pulse, low blood pressure, subnormal oral temperature and elevated rectal temperature.
4. Heat exhaustion may be regarded as the end result of overactive heat-balanced mechanisms that are still functioning, but heatstroke results when thermo-regulatory mechanisms are not functional, and the main avenue of heat loss (cooling by evaporation of sweat) is blocked.

5. Individuals who are unacclimatized, overweight, and fatigued; also heavy meals, hot foods, alcoholic beverages, fever, drugs, and tight clothing.
6. Frequent intake of water, salt, acclimatization, physical condition, work schedules, protection from the environment, and education.
7. Salt added at mealtime.
8. Personnel exposed to high temperatures, and especially supervisors.
9. Approximately two weeks.
10. The cooler hours of the day (e.g., early morning or late evening).

817

1. Chilblain, immersion foot, trench foot, frostbite, and hypothermia.
2. Prolonged exposure to cold, and usually wetness, at temperatures from just above freezing to 50°F.
3. Prolonged exposure to cold and loss of body heat.
4. Agent factors, environmental factors, and host factors.
5. Weather.
6. Those of lower ranks usually have a greater exposure, less experience in leadership, and have received less training.
7. Alcohol ingestion dilates the peripheral vessels and increases risk of cold injury.
8. In loose layers.

Do the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

13. (808) Three ways to prevent becoming a victim to hazardous flora and fauna are recognition, avoidance, and
    a. wearing gloves when reaching under things you cannot see.
    b. identifying hazardous flora and fauna.
    c. ensuring good personal hygiene.
    d. antivenins.

14. (809) Why should wastes be removed and disposed of promptly?
    a. Camp morale will decrease.
    b. Enemy troops will easily identify our position.
    c. To ensure the environment is protected and our position is not detected.
    d. To prevent the camp from becoming a breeding area for flies, rats, and other vermin.

15. (809) Who is responsible for ensuring all 4E0X1 personnel are trained in field sanitation?
    a. MTF commander.
    b. Career field manager.
    c. Superintendent, public health.
    d. OIC or NCOIC of public health.

16. (810) Which vehicle is *best* to use for transporting disinfected perishable subsistence for a long distance?
    a. A refrigerated truck used for equipment and supplies.
    b. An uncovered 2 $^{1}/_{2}$ ton transportation vehicle.
    c. An armored personnel carrier.
    d. The commander's jeep.

17. (811) How many seconds does it take to sanitize equipment when immersing it in boiling water?
    a. 15.
    b. 20.
    c. 30.
    d. 60.

18. (812) What kind of water is *most* likely to be selected as a source of water for a deployed unit?
    a. Existing public supply.
    b. Surface.
    c. Ground.
    d. Bottle.

19. (812) What chemical agents are most commonly used for chlorinating water in the field?
    a. Iodine and calcium phosphate.
    b. Iodine and sulfuric acid tablets.
    c. Sodium hypochorite and calcium phosphate.
    d. Sodium hypochorite and hypochlorite powder.

20. (813) When a water trailer arrives from a filling point, it is necessary to check chlorine residual to
    a. determine if dust particles are in the water.
    b. make sure the driver went to an approved point to collect the water.
    c. determine if the water trailer has stains on the interior surface resulting from rust.
    d. check if chips and cracks on the interior surface of the trailer are producing bacteria.

21. (813) What office is responsible for performing chlorine/pH microbacteriogical water testing?
    a. Bioenvironmental engineering.
    b. Preventive medicine.
    c. Civil engineering.
    d. Public health.

22. (814) How many feet must latrines be located downwind from food facilities?
    a. 50.
    b. 100.
    c. 200.
    d. 300.

23. (814) When "closing" latrines, how many inches deep should the covering of dirt be?
    a. 24.
    b. 18.
    c. 12.
    d. 6.

24. (814) The depth of a deep pit latrine depends on the
    a. distance from the camp.
    b. number of personnel using it.
    c. type of waste being disposed.
    d. length of time the latrine will be used.

25. (814) When the soil is hard, rocky, or frozen, which type of human waste disposal device is recommended?
    a. Burn-out latrine.
    b. Cat-hole latrine.
    c. Deep pit latrine.
    d. Straddle trench latrine.

26. (815) What is added to and used prior to soakage pits to drain kitchen wastes?
    a. A chlorine solution.
    b. Heat treatment.
    c. Insecticides.
    d. Grease trap.

27. (815) How should units without contractor support dispose of medical waste?
    a. Burial or incineration.
    b. Empty into a soakage pit.
    c. Empty into a chemical latrine.
    d. Transport to an evaporation bed.

28. (816) Which heat disorder is a medical emergency that requires immediate medical treatment?
    a. Heat exhaustion.
    b. Heat syncope.
    c. Heat cramps.
    d. Heatstroke.

29. (816) Which symptom is significantly *different* in heatstroke than in heat exhaustion?
    a. Rapid pulse.
    b. No sweating.
    c. Absence of nausea.
    d. Persistent headache.

30. (817) Hypothermia may occur under *all* of the following weather conditions *except*
    a. 30°F and snowing.
    b. 30°F and dry.
    c. 60°F and raining.
    d. 70°F and dry.

31. (817) All body areas are easily frosbitten *except* the
    a. feet.
    b. chest.
    c. hands.
    d. cheeks.

Please read the unit menu for unit 3 and continue ➔

Unit 3. Contingency Operations

Page

THIS unit explains the need and purpose for contingency operations in wartime. You'll study nuclear, biological, and chemical agents followed by detection procedures, required protective measures, and decontamination procedures for personnel and food.

3–1. Public Health's Role in Contingency Operations

The Air Force must be prepared to fight a war if necessary. We're all part of that mission even if we only support those who fight. We are Air Force members first, medical personnel second, and public health personnel third. However, this does not decrease our responsibilities for completing the public health mission. This section covers our wartime duties and responsibilities.

818. Contingency operations purpose

Your medical unit must be prepared to carry out its assigned wartime mission. This preparation is accomplished through effective planning and training. Planning for wartime contingencies was discussed in unit 1. The medical mission is actually twofold:

1. Return sick or injured combatants back to duty as quickly as possible.
2. To ensure the more seriously injured get evacuated to safer areas for convalescence and treatment.

Public health's mission in wartime is to prevent personnel from becoming patients due to illness. During a conflict, medical units will be placed within theaters or areas of combat operations (e.g., European theater and the Pacific theater).

Deployable teams

In support of contingency operations of medical care and the need to sustain operations, the Air Force has recognized the need for deployable teams. Deployable teams are the smaller elements or unit type codes (UTC) that make up the larger medical echelons. Each of these teams serves a specific purpose and role, providing medical care to deployed personnel. Examples of deployable teams include the patient decontamination team, FFGLB (2E mobile decontamination unit), and the FFGLA (equipment package to form the 19-person patient decontamination team).

Terrorism

In this age of political unrest, terrorism has become a very real threat throughout the world. It would not be unrealistic for a base's water or food supply to be the target of a terrorist attack using nuclear, biological, or chemical means. As in a natural disaster, we must be ready to handle these situations as they arise, including the evaluation of food and water supplies. We should make recommendations for the decontamination or disposition of food and assist bioenvironmental engineering services (BES) with the decontamination or disposition of water supplies in accordance with this unit.

819. Nuclear, biological, and chemical events

Each time a nation attains the technology for producing nuclear, biological, and chemical (NBC) weapons, the threat of NBC agent use continues to grow. We must know about the effects of these agents and develop a plan for medical management of casualties. In this lesson, we'll study the effects of NBC agents. There have been many NBC incidents in history—both in peace and war—that stress the importance of being *medically* ready. We must use these historical events to train our personnel on their duties in real life situations, and we must hold exercises to practice our skills and test our knowledge.

Nuclear events

Information about the effects of nuclear warfare is limited because nuclear weapons have been used only twice in war. There have been several peacetime incidents that provide us tremendous knowledge for medical readiness operations. A few examples of both wartime and peacetime nuclear incidents follow:

World War II

The United States Army Air Corps was the first to use a nuclear weapon in warfare. This occurred at 0840 hours on 6 August 1945. The B-29 *Enola Gay* dropped a 15-kiloton atomic (little boy) bomb on the Japanese island of Hiroshima. One hundred and forty thousand people were killed.

On 9 August 1945 the B-29 *Boxcar* dropped a 15-kiloton atomic bomb on the Japanese island of Nagasaki, instantly killing 73,000 people. Lessons learned from Hiroshima and Nagasaki still serve us well today. In both cases generations have suffered the long-term mutagenic and teratogenic effects of radiation exposure.

Goldsboro, North Carolina

On 23 January 1961 a B-52 bomber crashed carrying two 24-megaton weapons. Both weapons were removed intact and without detonation.

Palomores, Spain

On 17 January 1966 another B-52 bomber crashed. Four 20–25 megaton hydrogen bombs fell out of the aircraft. Two of the bombs were recovered undamaged, although the underwater search for one took almost three months. The other two bombs exploded conventionally (non-nuclear detonation) spreading plutonium over a wide area of grassland. Approximately 1,750 tons of radioactive soil and vegetation were eventually removed.

Thule, Greenland

On 21 January 1968 a B-52 with several 4-megaton bombs on board crashed into Thule Bay. The mass of the wreckage, both bombs and aircraft, melted through the thick ice and sank into the bay. Some bomb fragments were found, and several tons of contaminated snow were removed.

Three Mile Island, Pennsylvania

A nuclear accident occurred at a nuclear power plant releasing low-level radioactive material into the atmosphere. Radiation experts did not consider the amount of radiation released to be immediately dangerous to the surrounding area. However, there is great concern about the long-term effects on people and the food chain. There are research projects still being conducted to determine the exact effects of radiation.

Chernobyl, USSR

On 26 April 1986 a nuclear accident occurred at a nuclear power plant, releasing large amounts of radioactive material. Thirty-one people were killed and 137 experienced acute radiation syndrome. Hundreds of thousands were evacuated, and some permanently removed from their homes. According to the EPA, more radioactive material was released into the atmosphere from this accident than from all nuclear tests conducted throughout history. This caused panic throughout the world and exposed 17 million people to radiation.

We did not go into great detail on these situations; however, we have gained knowledge in medical readiness from these incidents. We must take the information gained from past experiences and develop ways to prevent them from happening again. Some of the primary concerns after a nuclear incident are a safe food and water supply and the protection of personnel from radioactive fallout. Also, ways to handle, protect, and decontaminate patients, materials, and equipment must be developed.

Biological events

We have seen how diseases occurring naturally can impact a military operation. Can you imagine the effect of disease-producing microorganisms being planted—intentionally? Biological warfare has been around a long time. It was used in the Middle Ages and during the French and Indian Wars. The threat of biological weapons being used against US military forces is broader and more likely than at any point in our history. Therefore, awareness of this potential threat and education of our troops and medical personnel are crucial.

World War II

From 1937 to 1945 Japan had an ambitious biological warfare program in Manchuria. In a laboratory complex code named "Unit 731" the Japanese conducted biological warfare agent experiments on prisoners of war. Over 3,000 POWs died as a result of the experiments. The Japanese dropped plague-infected fleas over China and Manchuria, causing epidemics of the disease. Later during WWII, the Nazi underground placed people in the food canning industry in New York. In 1939, the Federal Bureau of Investigation caught the group introducing *Clostridium botulinum* into food destined for the British troops. The cans arrived swollen and leaking; however, none of our troops reported ill, and a tremendous amount of food was lost.

Desert Storm

In 1995 it was revealed by United Nations inspectors that Iraq had a sophisticated biological warfare (BW) program in place during Operation Desert Storm in 1991. Iraq's total BW arsenal consisted of 19,000 liters of concentrated Botulinum toxin (10,000 liters in munitions), 8,500 liters of concentrated anthrax (6,500 liters in munitions) and 2,200 liters of aflatoxin (1,580 liters filled into munitions). Even when confronted with defeat, Sadam Hussein chose not to use his arsenal, probably due to fear of nuclear retaliation.

Modern-day terrorism

In the mid-1980s the Rashneesh religious clan sickened almost 1,000 people in the small town of Antelope, Oregon by sprinkling salad bars with Salmonella organisms in order to influence the results of a local vote. Their goal was to keep people away from the polls on election day. Today, there are opportunities for terrorists to contaminate our personnel or food using disease agents. The terrorist threat is a real concern that affects all military members.

Chemical events

The use of chemical weapons dates from at least 423 B.C. when, during the Peloponnesian War, allies of Sparta took an Athenian-held fort. They directed smoke from lighted coals, sulfur, and pitch through a hollowed-out beam into the fort.

World War I

On 14 April 1915 in Yepres (Belgium), German units released 130 tons of chlorine gas from 6,000 cylinders. The attack killed less than 800 troops by asphyxiation, but was more psychologically devastating to the more than 15,000 allied troops, who promptly retreated. Again on 12 July 1917, in Yepres, German artillery shells delivered a new kind of chemical agent, sulfur mustard, which caused 20,000 casualties. This new "blister" agent caused burns to the skin, eyes, and lungs of affected troops.

Bhopal, India

Early one morning in December 1984, there was an accidental release of methyl isocyanate gas into the atmosphere. With a slight breeze, the gas cloud spread to the surrounding areas, killing more than 2,000 people and injuring hundreds of thousands more.

Transportation accidents

The Environmental Protection Agency (EPA) reported that on average, one barge accident occurs every day, worldwide, where hazardous materials are the cargo. This agency also reported that between 1980 and 1985, 135 people died and 4,717 were injured in chemical accidents. One-quarter of these deaths and injuries were related to the transportation of hazardous chemicals.

Iran-Iraq

In February 1986, it was reported in several news sources that chemical agents, specifically mustard and nerve agents, were used to stop the Iranian military advances. In March 1991 near Kamisiyah, Iraq, US troops blew up a stockpile of Iraqi chemical weapons containing the nerve agent Sarin and "blister agent" mustard gas. Over 21,000 coalition troops were within a 30-mile radius. Investigations continue to see if this event is related to the "Gulf War Syndrome" of illnesses affecting many Gulf War veterans.

Japan, 1995

In March 1995, the Japanese doomsday cult called the "Supreme Truth Sect" unleashed the toxic nerve agent Sarin into five Tokyo subways, killing 11 people and injuring 5,500 more. This incident highlights the potential threat of NBC agents being used by terrorist groups.

820. Nuclear agents

There are three types of injuries associated with a nuclear weapon detonation:

1. Blast.
2. Thermal.
3. Radiation.

Blast

About 50 percent of the total energy in a nuclear explosion is released in the form of a blast. The rapidly expanding fireball produces a blast wave that travels outward from the site of the explosion. It is composed of static and dynamic components that are capable of producing medical injuries and structural damage. The static component is more commonly known as blast wave or static overpressure. The dynamic component is known as blast wind. It is produced by and proportional to the difference between the blast wave pressure and the ambient atmospheric pressure. Both occur simultaneously, and the resultant effects are synergistic.

Blast wave injuries

The blast wave is a wall of compressed air that exerts a crushing effect on objects in its path. Normal atmospheric pressure is 14.7 pounds per square inch. Near ground zero, it may be several times normal. Exposure to this high pressure produces primarily internal injuries—ruptured eardrums, chest injuries, pulmonary rupture, hemorrhage and air embolisms (gas bubble), and other internal organ damage.

Blast wind injuries

The blast wind that accompanies the blast wave may exceed 200 mph. Depending on the wind speed and object size, debris carried by the wind may cause missile injuries (e.g., lacerations, contusions, fractures) and blunt trauma. Also, wind velocity of 100 mph will displace a person, which can cause lacerations, contusions, and fractures from tumbling across the ground and being thrown into stationary objects.

Thermal

Scientists have stated that about one-third of the total energy in a nuclear explosion is in the form of heat radiation. The fireball yields heat estimated to be millions of degrees in temperature. At Hiroshima the heat energy ignited clothing, grass, and dry wood up to 3,500 feet (ft) from ground zero. Two types of fires result from a nuclear explosion:

1. Primary fires—ignited by the initial heat wave of the detonation.
2. Secondary fires—caused indirectly by the blast (e.g., from overturned stoves, broken gas pipes, electrical short circuits).

Results

The number of fires varies according to the season, atmospheric conditions, type of terrain, type of burst, weapon yield or size, and many other equally important factors. It is speculated, however, that within one-half mile from ground zero of a 20 kiloton (KT) explosion there will be an area of nearly complete destruction where mass fires may be expected in the first hour. In a 20 KT detonation, anticipate many fires within one mile of ground zero. Of course, the effects of higher yielding weapons are greater.

Injuries

The types of injuries resulting from thermal energy are:

- Burns—flash burns and flame burns.
- Eye injuries—flash blindness and retinal burns.

The severity of these injuries is directly related to the distance from the detonation. The initial thermal flash and heat wave travels in a straight line at the speed of light (186,000 miles per second). Initial injuries will be flash blindness temporarily caused by light overwhelming the eyes retinal rods and cones. Intense heat or light may cause retinal burns, resulting in permanent blindness. The thermal wave also causes flash burns to the skin from high-intensity low-duration heat exposure. As objects in the environment heat up and begin to burn, massive fires and firestorms result. Burn victims experience first, second, and third degree burns.

Radiation

About 15 percent of the energy released from a nuclear weapon is radiation. Radiation makes normally stable elements radioactive. Generally, there are two types of radiation associated with a nuclear detonation—initial and residual.

Initial

Initial radiation consists of neutrons and gamma rays produced within the first minute after detonation. The main hazard associated with initial radiation is acute external whole-body irradiation by neutrons and gamma rays (ionizing radiation). When this occurs, high electromagnetic wave energy passes through the body. It displaces electrons from neutral molecules producing positive and negative ions. These new chemicals, ions, cause damage to the cells and produce biological effects.

Residual

Residual radiation primarily includes gamma rays, beta particles, and alpha particles. They are produced by the decay of the radioactive materials, bomb components, and surface materials made radioactive from the detonation. We call this radioactive debris "fallout." The heavy, local fallout is usually visible as a dust-like deposit on surfaces. The biological hazards of fallout include whole-body irradiation from fallout on the ground, beta particles on the skin, and internal damage caused from ingested or inhaled alpha and beta particles. Late effects of radiation exposure in survivors include some cataracts, genetic mutations, birth defects, and cancer.

Upon a nuclear detonation, these radioactive contaminants are spread over great distances. However, the type of nuclear detonation affects the spread of the radioactive materials. The three most common types of nuclear detonation are:

1. Air bursts.
2. Surface bursts.
3. Subsurface bursts.

Air burst

The air burst is a detonation in the atmosphere where the fireball does not touch the ground. It causes the least radiological hazard because most of the radioactive contamination is spread throughout the atmosphere with less reaching the ground. However, this type of burst can affect personnel by the radioactive contamination attaching to rain droplets and falling to the ground where it may enter the food chain. One consequence of a high-altitude nuclear detonation is electromagnetic pulse (EMP) or the release of high energy. Electromagnetic waves from the detonation overwhelm the circuitry of all mechanisms using electricity, destroying or disabling them. Can you imagine the impact of no electricity or communications capability in a wartime environment?

Surface burst

The surface burst is a detonation at ground level where the fireball contacts the ground. It is the most hazardous type of nuclear detonation. The burst directly contaminates the area around the blast with high levels of radioactivity. In addition, the surface burst causes massive amounts of radioactive debris to be drawn up into the atmosphere. Later, this radioactive material rains as fallout many miles away resulting in a direct radioactive hazard or may indirectly threaten us by entering the food chain.

Subsurface burst

A subsurface burst is a detonation below ground or water. The subsurface burst is considered less hazardous. It contaminates the soil and ground water in the area of the blast. However, there's little fallout because not much debris is drawn up into the atmosphere. This method is generally used to test nuclear weapons.

821. Biological warfare

Biological warfare is the use of microorganisms or toxins derived from living organisms to produce death, disease, or toxicity in humans, animals, or plants.

Types

We will cover three basic types of biological agents—bacteria, viruses, and toxins.

Type	Description	Examples
Bacteria	Can cause diseases in humans and animals in two ways: invading tissues and by producing poisons (toxins).	– Bacillus anthracis (Anthrax) – Yersinia pestis (Plague) – Francisella tularensis (Tularemia) – Coxiella burnetii (QFever)
Viruses	Simplest type of microorganisms that require a host cell to live and multiply.	– Smallpox (orthopoxvirus) – Venezuelan Equine Encephalitis (e.g., VEE alphavirus) – Viral hemorrhagic fevers (e.g., Ebola, Rift Valley fever, Lassa fever and Congo-Crimean hemorrhagic fever)
Toxins	Any toxic substance of natural origin produced by animals, plants, or microbes.	– Botulinum toxin – Staphylococcal enterotoxin B (SEB) – Ricin – Aflatoxins – T–2 mycotoxins

Methods of delivery

The primary object of a BW attack is people. BW agents are designed to kill or incapacitate our troops in order to gain a tactical advantage over our forces. The attack is either direct or indirect through air, food, water, or natural vectors. BW does not affect such things as buildings, housing, or factories; therefore, it is advantageous for the enemy to use a BW agent to incapacitate personnel—then they can move in to take over intact facilities. BW agents may be released from mortar and artillery shells, bombs, airplane spray, missiles, or by various methods of sabotage. They may appear in the form of powder, vapor, aerosol, liquid, or liquid droplets having the appearance of rain or dew. These agents may have little or no color, and they may be odorless.

Use of vectors and hosts

Living vectors can be used in biological operations. In volume 2 you learned how flies, mosquitoes, fleas, ticks, and lice carry diseases. Some vectors need intermediate hosts for disease to develop. These animals could be intentionally infected with a disease and placed near the enemy. If the proper vector is present, it is possible to start an epidemic in the enemy population.

Other methods

Other ways of introducing BW agents are:

1. Small dusting or spraying devices could be used to introduce agent material into ventilating systems of large office buildings, auditoriums, and theaters with little danger of detection.
2. Infective microbes and toxins could be pumped directly into city water distribution systems.
3. Enemy personnel working in food establishments might be in a position to contaminate foods.

4. Effective measures might also be developed to distribute pathogens on currency, stamps, envelopes, and in cosmetics, shaving soap, chewing gum, candy, and other articles.

Characteristics of BW agents

Biological agents can definitely affect our forces' ability to continue fighting. Therefore, we must be able to detect and identify these agents so that we can protect others and ourselves. Most BW agents, particularly the pathogenic microorganisms and toxins, have certain properties not possessed in general by other weapons.

Incubation period

Some BW agents have a delayed action. Often days must elapse from the time the victim is exposed until development of clinical signs. BW agents such as toxins (e.g., botulinum and saxitoxins) have immediate effects while others are more delayed in their manifestations.

Difficult identification

Identification of agents currently is difficult and slow because their presence cannot be detected by unaided senses. BW agent detectors are now being developed and field-tested, but for now we must depend on epidemiology and laboratory tests for identification. It takes hours, usually days, for agents to develop in an artificial medium or in animals, and for necessary tests of the suspected material to be made. Too much time may lapse between identifying the agent and finding a cure or recommending treatment. In the meantime, many of our troops may die.

Unlike other warfare agents

In contrast to other agents of warfare, the microorganisms are living agents. Under favorable conditions, pathogenic microorganisms can reproduce and multiply in the host. Therefore, small numbers of pathogens may in time constitute a grave risk to health or perhaps to life. Some contagious pathogens spread from individual to individual and cause epidemics. Most are also quite selective, attacking only certain species of animals or plants. Theoretically, a given weight of biological agent may be many times more dangerous than equal amounts of the most effective chemical agent. From a practical standpoint, the biological agent's activity or effectiveness is strictly limited by its ability to overcome the resistance of the target host and the environment. Biological agents lend themselves well to covert use because only small amounts need to be used, and they are easily concealed, transported, and used in sabotage operations. Because of the small amounts required, costs of biological agents may be much less than other agents or weapons.

822. Chemical warfare (CW)

Chemical warfare agents are substances (i.e., gaseous, liquid, or solid) which might be used because of their direct effects on man, animals, and plants. The key to protection from the effects of chemical weapons lies in knowledge of the various agents involved. Toxic chemicals are present in everyday industrial operations. Those used in CW are similar in many respects to those that are already familiar to you. The difference is the strength of the agent, the large area of coverage, and the fact you are a target rather than a casual bystander. Chemical agents attack the body and depending on the kind of agent used produce specific damage. There are different types of chemical agents, and you should know how each of them affects the human body. The types of agents we discuss are:

- Pulmonary agents.
- Cyanigens.
- Vesicants.
- Nerve.
- Incapacitating.

Pulmonary agents

Pulmonary agents were developed from dye fixatives used in the textile industry. The early signs and symptoms of exposure to pulmonary agents are generally limited to eye, nose, and throat irritation, with tearing and coughing. If the exposure is light and terminated quickly, these symptoms will subside in 15 to 30 minutes. However, if the exposure is severe, prolonged, or repeated lung problems will develop. Upon contact with moisture in the lungs, pulmonary agents convert to various acid compounds, which decrease the ability of the lung tissue to absorb oxygen. This is followed by inter and intracellular fluids filling the lungs, which is called pulmonary edema (dry land drowning). Even if properly managed, this condition may lead to death.

Cyanigens

Cyanigens have been used in metallurgy for centuries and in the acrylic and plastics industry since their beginning. Cyanides stop tissue respiration. Cyanides were not effective in WWI. The delivery systems of the day could not place enough cyanigen chloride, the blood agent used, in an area rapidly enough to derive the desired effects. Modern systems can now do this. Signs and symptoms are very rapid in onset, and death can occur in six to eight minutes. Headache, dizziness, confusion, labored and violent breathing, dilated pupils, and protruding eyes are early indications. These symptoms are followed by reddening of the skin, particularly the fingernail beds, violent convulsions, paralysis, coma, and respiratory arrest preceding death.

Vesicants

Vesicants in either liquid or vapor form are readily absorbed by both external and internal parts of the body. These agents cause inflammation, blisters, and general destruction of tissue. They can be effective in small amounts. A drop the size of a pinhead produces a blister the size of a quarter. Vesicants are most effective in hot weather because sweating increases the effect. These agents produce damage quickly, although blisters may not appear for hours or even days after exposure. Speed in performing first aid and decontamination is essential.

Damage to the eyes may be worse than the effects on the skin. At first, there may be no pain, but in a few hours eyes become painful, inflamed, and sensitive to light. Tears and intense pain follow, possibly leading to permanent injury. If breathed into the lungs, vesicants inflame the throat and windpipe and produce a harsh cough. Serious exposure may produce pneumonia and death. Systemic poisoning by vesicants changes the process of oxygen and nutrient transfer to outlying tissues causing necrosis (death of tissue), gangrene, and sloughing of the tissue. This kind of poisoning also suppresses white blood cells (WBC) and red blood cells (RBC), which causes infection and then death. Quick detection of vesicants, plus protection against entry into the eyes, lungs, or on the skin is vital. Mustards, phosgene oxime, and lewisite are a few types of vesicants.

Nerve agents

Nerve agents can be found in the fertilizer and insecticide industries. The nerve agents are esters of organophosphorus compounds. They inhibit the cholinesterase enzyme system causing an accumulation of acetycholine which causes the biological effects associated with nerve agents. The onset of symptoms is rapid, beginning with pinpointing of the pupils. These symptoms are followed by difficulty in focusing eyes, headaches, general weakness, profuse sweating, muscle tremors, tearing, and salivation. Later, nausea, vomiting, and loss of bladder and bowel control occur, resulting in severe dehydration. If untreated, violent convulsions, coma, and death may result. It is imperative that nerve agents in contact with the skin or eyes be neutralized or removed immediately. These agents are rapidly absorbed by the eyes and through cuts in the skin. They are absorbed through unbroken skin somewhat more slowly. Clothing contaminated with nerve agent must not be allowed to remain in contact with the skin. Speed in detection, masking, giving the alarm, and in self-aid is paramount. It may save your life. The following table describes what should be done when you hear one of the CW agents is present.

Type of Agent	Onset	First Aid	Skin Decon	Detection
Pulmonary agents: Phosgene (Organo- halides) (CG): • Isocyanates • Carbon tetrachloride • Methylene chloride • Trichloroethylene	Hours	Move upwind, mask	None usually needed	None
Cyanigens: Hydrogen cyanide (AC) Cyanigen chloride (CK)	Seconds	Nitrite and thiosulfate	None	M256A1
Vesicants: Lewisite (L) Phosgene oxime (CX) Mustards: • Sulfur (H and HD) • Nitrogen (HN)	Hours Immediate pain after exposure to lewisite	Lewisite: British Anti-Lewisite (BAL) IM All others use copious amounts of water to wash	M291, M258A1 bleach, water	M256A1 M8, M9 papers, CAM
Nerve agents: G-agents: • Tabun (GA) • Soman (GD) • Sarin (GB) • GF V-agent: • VX	Vapor: seconds Liquid: minutes to hours	MARK 1 (1 to 3) Atropine Pralidoxime Chloride Diazepam	M291 M258A1 bleach, water	M8A1 alarm, M256A1 M8, M9 papers, CAM

NOTE: In some countries, “V” agents are known as “A” agents.

Incapacitating agents

Incapacitating agents are any types of material that will keep people from doing their job, thus detrimentally affecting the mission. The number of these agents is so numerous and varied in effect that they cannot be covered adequately in this course. As their name implies, they are usually not intended to cause death—only temporarily incapacitate. Based on the types of injury they cause, incapacitating agents fall into three groups:

1. Agents that produce temporary visual, mental, and physical disabilities (e.g., blindness, or deafness).
2. Agents that produce temporary mental aberrations (e.g., confusion and hallucinations).
3. Agents that produce physical aberrations (e.g., paralysis, low blood pressure, vomiting, diarrhea, dizziness, and an abnormally high body temperature—hyperthermia).

These agents may cause an individual to become confused, disoriented, sleepy, excited, irritable, or unconscious. The tear gas (CS) you were exposed to in your mask confidence chamber is classified as an incapacitating agent.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

818. Contingency operations purpose

1. What is the twofold purpose of the medical mission in wartime?

2. What are UTCs?

819. Nuclear, biological, and chemical events

1. How can we effectively use the historical information from nuclear, biological, and chemical events?

2. The nuclear accident at Three Mile Island caused no immediate danger to radiation, but what concerns do experts have about the accident?

3. In 1995 it was revealed that Iraq had sophisticated biological warfare agents. What where they?

4. When was the first recorded use of chemical weapons?

5. What accident occurred in Russia on 26 April 1986?

6. What NBC agents were used by Iraq in 1986?

820. Nuclear agents

1. What causes most of the destruction during a nuclear weapon detonation?

2. Blast injuries are caused by which two blast components?

3. What types of fires would be caused by a nuclear weapon detonation?

4. What are the biological hazards from “fallout”?

5. What type of radiation presents the greatest inhalation hazard?

6. How much of an immediate radiological hazard would an air burst produce on the ground?

7. How does a nuclear burst result in radioactive contamination?

8. What type of nuclear detonation occurs where the fireball contacts the ground?

9. Which types of burst yield the most ground-level contamination?

821. Biological warfare

1. Why is using biological warfare agents advantageous?

2. How may biological agents be released into the environment?

3. What are the characteristics of biological warfare agents?

4. What determines the effectiveness of biological agents?

822. Chemical warfare (CW)

1. What chemical agent was developed from dye fixatives in the textile industry?

2. How do cyanigens affect the body?

3. In what type of weather are vesicants most effective?

4. What are the three examples of vesicants?

5. What is probably the first effect you will notice in a person exposed to nerve agents?

6. What are the effects of incapacitating agents?

3–2. NBC Detection Equipment

Public health uses detection equipment to determine NBC contamination of patients, food, and medical assets. To do this, you must know which measurement device to use, and how to operate it.

823. Detecting radiation

Radiological survey

The most rapid means of estimating the extent of radiological hazards is by an aerial survey using helicopters or slow-flying aircraft. The aerial survey provides immediate but incomplete information concerning radiation intensity and general area contamination. Ground surveys supplement this preliminary aerial survey in order to outline the exact danger perimeter (i.e., the outer edge of the area where dosages are greater than the maximum permissible dose for a certain period of time). The survey should determine what is contaminated, and not how much contamination is present. Ground surveys are usually accomplished by bioenvironmental engineering personnel; however, you may be asked to assist. The survey information is then used by the commanding officer, with consultation from the medical treatment facility commander, to establish the total exposure for personnel.

Radiation measurement

We are not equipped by nature to sense the presence of hazardous ionizing radiation. Our body is not naturally protected against radiation. Therefore, we must equip ourselves with the knowledge and means for detection and protection. The information in this section will help you understand how radiation detection instruments operate, and what specific purposes they serve. For complete operating instructions see the applicable technical order (TO) for each piece of equipment. All radiation detection equipment is usually referred to as RADIAC equipment. This acronym is formed from:

- **R**—Radio.
- **A**—Activity.
- **D**—Detection.
- **I**—Identification.
- **A**—And.
- **C**—Computation.

The readings you will obtain using the various RADIAC instruments will vary from one instrument to another. It is important that you understand the meaning of each unit of measurement as well as the differences between them. International standards are the common units used throughout the world. We will be converting to these units in the future. The following table identifies the units, and the definitions have been simplified from the actual scientific explanations.

Unit	International Standard	Definition
Roentgen (rent'gen)	The international unit for measuring X-rays or gamma rays.	By analogy, a roentgen is a unit of radiation like a minute is a unit of time.
Milliroentgen	N/A	1/1,000 of a roentgen.
Roentgen equivalent in man (REM)	***Sievert (Sv).*** The sievert is a unit used to derive a quantity called equivalent dose. This relates the absorbed dose in human tissue to the effective biological damage of the radiation. Not all radiation has the same biological effect, even for the same amount of absorbed dose. Equivalent dose is often expressed in terms of millionths of a sievert, or micro-sievert. To determine equivalent dose (Sv), you multiply absorbed dose (Gy) by a quality factor (Q) that is unique to the type of radiation. One sievert is equivalent to 100 REM.	This term considers how radiation acts on humans. **NOTE:** Various components of radiation react differently with various materials. This term takes into account the absorbed amount of radiation and the relative biological effect from that amount relative to the effect that would result from 1 roentgen of X ray or gamma.
Millirem	N/A	1/1,000 of one REM. For the purposes of radiation detection, the roentgen and the REM are approximately equivalent levels of radiation.
Curie (Ci)	***Becquerel (Bq).*** The becquerel is a unit used to measure radioactivity. One becquerel is that quantity of a radioactive material that will have one transformation in one second. Often radioactivity is expressed in larger units like: thousands (kBq), millions (MBq) or even billions (GBq) of a becquerels. As a result of having one becquerel being equal to one transformation per second, there are 3.7×10^{10} Bq in one curie.	The curie is a unit used to measure a radioactivity. One curie is that quantity of a radioactive material that will have 37,000,000,000 transformations in one second. Often radioactivity is expressed in smaller units like: thousandths (mCi), one millionths (uCi) or even billionths (nCi) of a curie. The relationship between becquerels and curies is 3.7×10^{10} Bq in one curie.
Rad (radiation absorbed dose)	***Gray (Gy).*** The gray is a unit used to measure a quantity called absorbed dose. This relates to the amount of energy actually absorbed in some material and is used for any type of radiation and any material. One gray is equal to one joule of energy deposited in one kg of a material. The unit gray can be used for any type of radiation, but it does not describe the biological effects of the different radiations. Absorbed dose is often expressed in terms of hundredths of a gray, or centi-grays. One gray is equivalent to 100 rads.	The rad is a unit used to measure a quantity called absorbed dose. This relates to the amount of energy actually absorbed in some material, and is used for any type of radiation and any material. One rad is defined as the absorption of 100 ergs per gram of material. The unit rad can be used for any type of radiation, but it does not describe the biological effects of the different radiations.

Radiological survey instruments

Survey instruments may be defined as devices that translate radiation into voltage or current, which may then be read on a meter. Various types of RADIAC instruments are required to detect and measure types and quantities of radiation. These devices can generally be divided into two different categories—total dose and dose rate.

Total dose

These are direct reading instruments used to give the wearer an estimate of exposure to X or gamma radiation during the exposure. Total dose instruments are used to register an accumulated amount of radiation exposure. By continuously adding up the exposure amounts, they enable the wearer to limit exposure to the permissible level. Examples of the total dose instruments are the pocket dosimeter and the thermoluminescence dosimeter (TLD).

Figure 3–1. Pocket dosimeter.

Pocket dosimeters

A pocket dosimeter is nothing more than a miniature quartz fiber electroscope (i.e., a movable electrode and an optical system) roughly the size of a fountain pen (fig. 3–1). The amount of radiation exposure can be measured by viewing through the lens the line that crosses a calibrated scale. Individual dosimeters are usually limited in their range. Several ranges are available (e.g., 0 to 200 miliroentgens and 0 to 600 roentgens).

Thermoluminescence dosimeters

TLD badges not only record X-ray and gamma radiation, but also beta radiation. These badges do not detect alpha or any nonionizing radiation such as radio frequency, microwave, or ultraviolet radiation. Because these instruments can be reused, once the information recorded on the internal thermoluminescence crystals or elements is analyzed, it is removed. Thermoluminescence dosimeters have been accepted as a replacement for film badges in the Air Force as well as the US Public Health Service and some civilian nuclear agencies. Some special TLD badges are designed to measure neutron radiation.

Dose rate instruments

These instruments measure radiation exposures at specific points in time rather than accumulated exposure over a period of time. The readings are rates of exposure. With a constant dose rate, an estimate of an individual's total dose can be determined by multiplying the dose rate times the period of exposure:

Example:

50 mr/hr (dose rate-reading)

$\times$ 2 hrs (time exposed)

100 mr (total dose)

The dose rate instruments we discuss are the ones you will probably use at your base. More specific information concerning the actual operation, inspection, and calibration of RADIAC instruments can be found in the appropriate technical orders.

ADM 300

The ADM 300A, Kit C (fig. 3–2) is lightweight, self-diagnostic, auto ranging, and has both visual and audible alarms. Through the use of many different probes, the ADM 300 can be used to detect and measure alpha, beta, gamma, and X-ray radiation. The main unit of the ADM 300 measures gamma and detects beta radiation. The "C" model (medical kit) is outstanding for patient and subsistence monitoring, prior to decontamination. The ADM 300 can be ordered using national stock number 6665–01–320–4712. To learn more about the ADM 300 read TO 11H2–2–31.

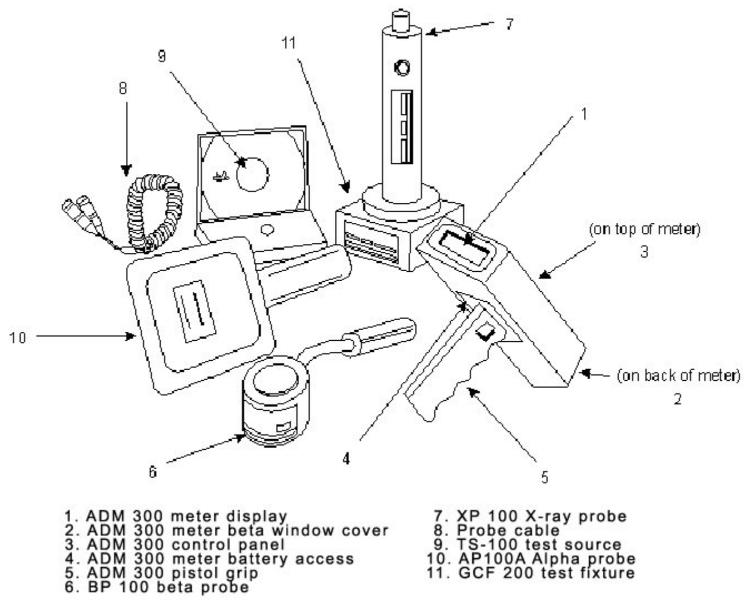


Figure 3–2. ADM 300.

824. Detecting biological agents

Since you cannot see, feel, or taste germs spread in a BW attack, the detection and identification of BW agents generally require several days or weeks, and can only be done by trained personnel. The appearance of certain clues, however, may warn you or cause you to suspect a BW attack:

1. Aircraft dropping unidentifiable material or spraying unknown substances.
2. Unusual shells or bombs, particularly those that burst with little or no blast.
3. Smoke or mists of unknown origin.
4. Unusual substances on the ground or vegetation (e.g., unexplained glass bottles or other breakable containers lying on the ground).
5. Unusual numbers of sick or dead animals.
6. Epidemics and nonindigenous diseases.
7. Mass casualties.
8. Large increase in respiratory diseases.

Reporting

Epidemiological studies are used to detect a sudden increase in cases of a particular disease or the sudden appearance of an unusual disease. Through these studies, we might be able to determine if the situation is due to natural causes or a biological attack. To control or prevent epidemics from biological attacks, prompt reporting of sickness must be done quickly. Prompt reporting of sickness serves three purposes:

1. It allows early treatment of the disease.
2. It enables medical personnel to identify the biological agent to which the individuals were exposed.
3. It helps to prevent the spread of disease from person to person.

Once the disease has been identified, effective medical measures can be taken.

Sampling

Field sampling is the actual collection of organisms from air, water, terrain, or other suspected media. Sampling generally cannot be undertaken as a matter of routine. Therefore, to be practicable, sampling must depend on some means of warning to indicate when and where sampling is warranted. To establish the identity of a BW agent, it is desirable to collect the sample from the primary source. If the agent is dispersed in the form of a cloud, the length of time the agent will remain on a station depends largely on wind velocity and the length of time the dispersing apparatus is in operation. The ideal location from which to sample a cloud of BW agent is:

- Directly downwind from the point of release.
- In the open so that trees, buildings, hills, or similar obstacles will not interrupt the path of the cloud.
- In the case of sprays from aircraft, far enough away from the point of release for the spray to have settled to ground level.

In the case of munitions, the best samples would be at or near the point of release. The concentration of agent should be highest at that point. Fragments from munitions, leaves of vegetation, stones, and other debris near the point of release provide excellent samples and should be forwarded to the laboratory.

825. Detecting chemical agents

You are one of the best chemical agent detectors there is. Being aware of the chemical threat around you and searching for clues, you may identify the possibility of chemical warfare agents in your area of responsibility (AOR) before any other device. Always put on your protective equipment first (to protect yourself); then use your detection equipment. While you might be able to detect some level of a chemical warfare agent with your five senses, you would be needlessly exposing yourself to potentially lethal levels of chemical warfare agents without your equipment. The best way to detect and identify chemical agents is to use detection devices and tests made with detector kits. The most widely available kits in the USAF are:

- Chemical agent monitor (CAM).
- M8A1 and M90 chemical agent alarms.
- M256A1 chemical agent detector kit.
- M272 water test kit.
- M8 paper.
- M9 tape.

Chemical agent monitor

The CAM was invented by Graseby Ionics in the United Kingdom in 1984. The CAM saw its first widespread use by the DOD during Desert Shield/Storm. Public health adopted the CAM into TA 902 for use on the patient decontamination team and for detecting chemical warfare agents on subsistence.

The CAM detects G-nerve and H blister (vesicant) agents. This monitor responds to vapors down to the lowest concentrations that could affect personnel over a short period of time. The CAM (fig. 3–3) is powered by a 6-volt lithium battery, or it can be powered using battery auxiliary training (BAT), consisting of four D-cell batteries for training use. The CAM contains a Nickel–63 (Ni–63) 10 millicurie source that works on the principle of ion mobility spectrometry. Using an impinger, the CAM sucks air in and runs it over the Ni–63 source where the ionization occurs. Once ionized, G and H vapors are detected by virtue of the speed they travel across the ion chamber. Although an effective detection instrument, the CAM does have the following limitations: false positives are possible from cleaning compounds, perfumes, peppermint, menthol cigarettes, and smoke and fumes from rockets and munitions. Because of these limitations, results should be validated using other equipment appropriate to the type of contamination detected.

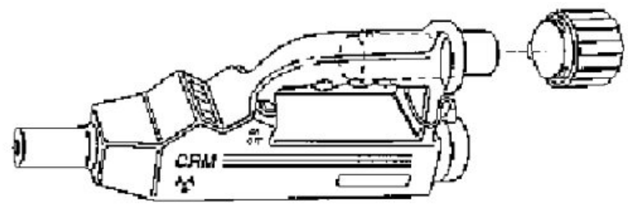


Figure 3–3. Chemical agent monitor (CAM).

Public health offices possessing a CAM are required by the Nuclear Regulatory Commission (NRC) to register the CAM through the base radiation protection officer (RPO). The RPO must issue a permit for keeping the CAM on base, and issue a permit if the CAM will be moved off-base. To order the CAM use NSN 6665–01–199–4153. For information on the working operations of the CAM read TO 11H2–20–1.

M8A1 chemical agent alarm

The M8A1 is made up of the M42 alarm and the M43 detector. This alarm is more sensitive than its predecessor, the M8 alarm. However, the M8A1 does not have the blister agent detection capability of its predecessor and only detects nerve agents. Both units come with a 400-meter cord to set the detector upwind from the alarm. This piece of equipment normally belongs to disaster preparedness personnel. Public health personnel normally would not use this piece of equipment, but he or she should be aware of its capabilities and plan the alarm response. There is no need to order the M8A1 since it will be replaced by the M90 chemical agent alarm.

M90 chemical agent alarm

In 1996, 231 M90s were fielded to overseas Air Force bases. The M90 detects nerve agents, vesicants, and cyanigens. It also provides agent concentration level information as low, medium, or high. The M90 interfaces with local field radio communications and computer networks. The detector is connected to the remote alarm center and horn by a 2,000M cord.

M256A1 chemical agent detector kit

The purpose of this kit is to detect and classify chemical agents present in vapor and liquid form. The kit is capable of detecting the presence of nerve agents, cyanigens, and vesicants in 16 minutes. The kit (fig. 3–4) is an expendable item that consists of a carrying case, 12 sampler detectors, and one book of 25 sheets of M8 detector paper. Each sampler detector consists of eight glass ampules filled with a chemical reagent, three test spots, a chemical heater, and a lewisite-detecting tablet. Instructions are included on cards in the carrying case and on the sampler detector packets. There are a few limitations with this kit. The results are determined by matching, as nearly as possible, the color results with the colormetric result chart. The colors of the results may not match the chart. The results are qualitative not quantitative, which allows for deviation. There is also a very limited agent-specific identification capability with this kit. This kit may be used to determine whether chemical agent vapors are present in air prior to unmasking procedures. This kit is also useful identifying dangerous off-gassing levels on a patient during the decontamination process. To order, use NSN

6665–01–133–4964. To improve your knowledge of the working operations of this kit study TO 11H–2–21–1.

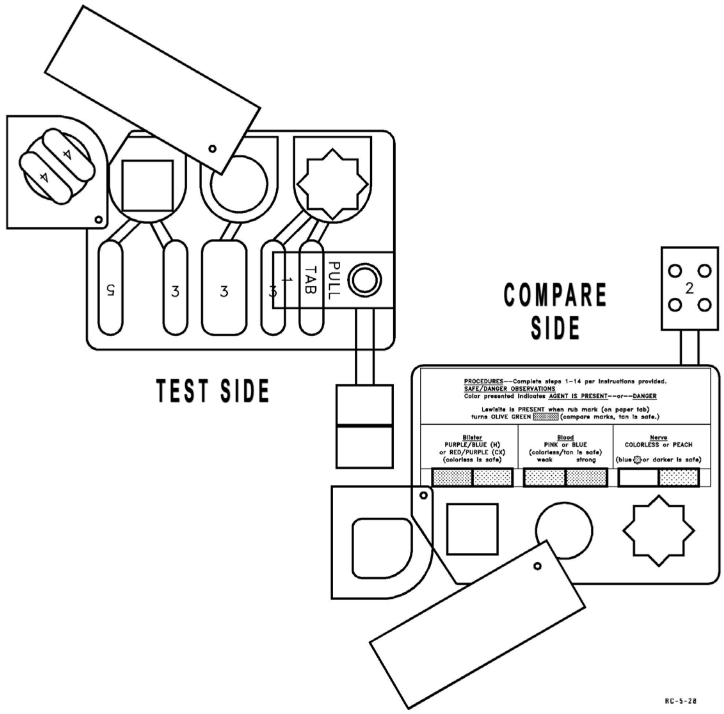


Figure 3–4. M256A1 Chemical agent detector kit.

M272 water test kit

The M272 is capable of detecting nerve agents, cyanigens, vesicants, and lewisite agents in drinking water. The kit (fig. 3–5) contains a 100-ml test tube, blue and red-colored banded tubes, and numerous colored packages that contain mixes to test your water sample. The best way to learn how to use the M272 is to use it while wearing your MCU–2P protective mask and rubber gloves. During real-world chemical threats, you’ll use the kit under MOPP 4, and you will follow the instructions on the enclosed card. The series of four tests for lewisite, nerve agents, cyanigens, and vesicants takes approximately 40 minutes. Public health will use this kit when assisting BES with checking drinking water, or to detect agents in water that may be used for patient decontamination. To order this kit use NSN 6665–01–134–0885t.

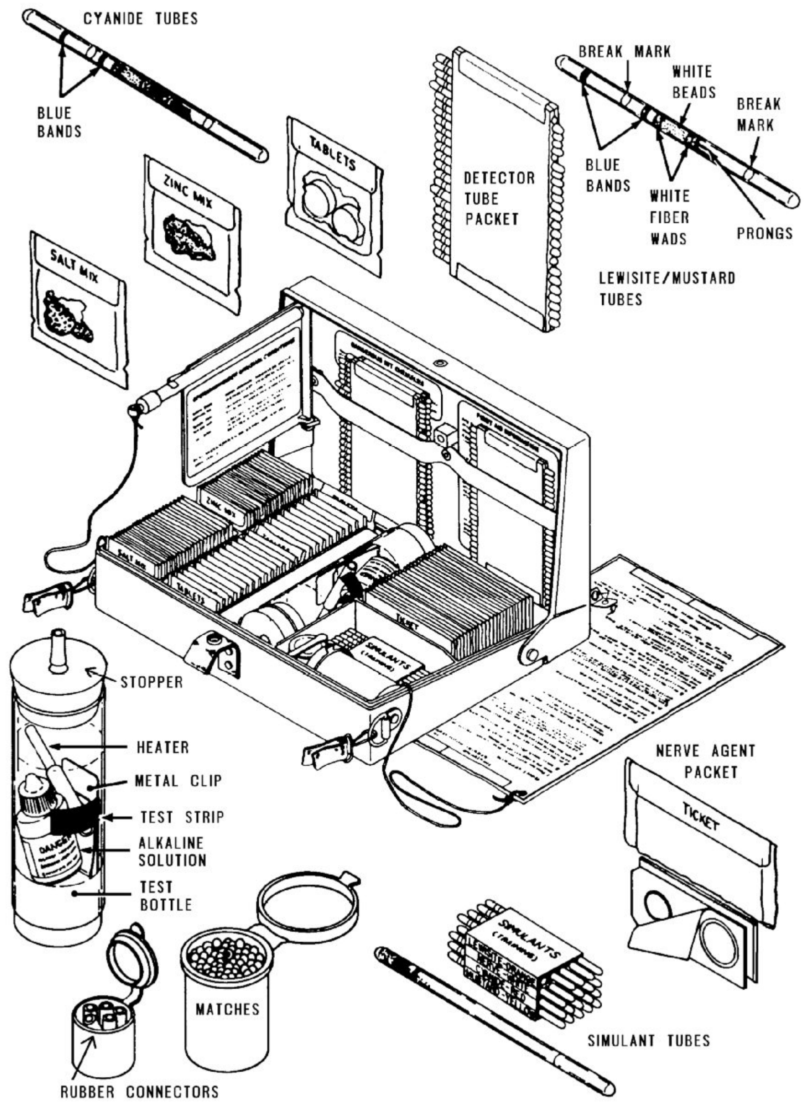


Figure 3–5. M272 water test kit.

M8 paper

Manufactured by our Canadian allies, M8 (fig. 3–6) paper is capable of detecting liquid chemical warfare agents. It detects G-nerve, H-blister (vesicant), and V-nerve agents, resulting in a brown, red, or green (respectively) color response. M8 paper may be useful in patient decontamination or subsistence monitoring procedures. Although M8 paper is a useful tool in our detection arsenal, you must be aware of its limitations. Many insect repellents (e.g., DEET) will cause a positive G agent response, and Ethylene Glycol (antifreeze) can cause a V agent response. If used with common sense, M8 paper is the best liquid-agent detector available to public health personnel. To order M8 paper use NSN 6665–00–050–8529, and to understand the proper working operations of the M8 paper study TO 11H2–14–5–1.

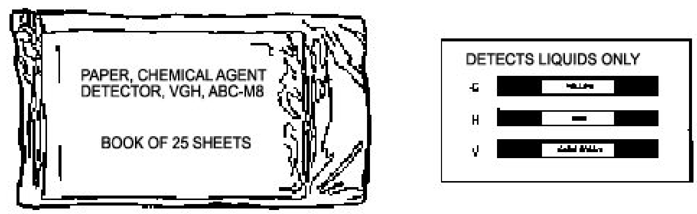


Figure 3–6. M8 paper.

M9 tape

M9 tape (fig. 3–7) has one sticky side, allowing users to apply it to many different surfaces; and it reacts quicker to liquid chemical agents than M8 paper. Unlike M8 paper, M9 tape turns only one color—red or some shade of red. M9 tape will give you an immediate reading that lets you know some agent is present. Further identification of the agent will be necessary either with the M8 paper or CAM. M9 tape is usually placed on the outside of your ground crew ensemble, on your nondominant wrist, your dominant arm, and nondominant leg. Some MAJCOMs require users of M9 tape to place strips around each forearm, each bicep, each thigh, and each ankle. M9 tape can also be placed on any surface that may be subject to contamination—outside the hospital, on vehicles, around the patient decon area, or on any other surface. The only limitation of M9 tape is that petroleum products and insect repellents will cause false positives. To order M9 tape for your unit use NSN 6665–01–049–8982 and read TM 3–6665–311–10 to better understand the proper use of M9 tape.

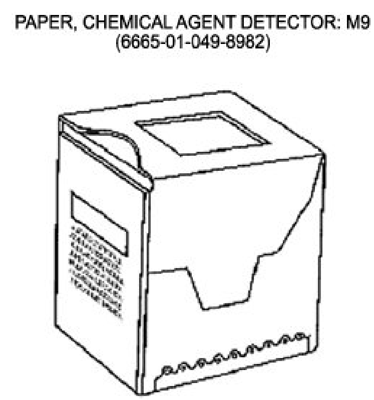


Figure 3–7. M9 tape.

Chemical detection without kits

Chemical agent detection and identification should be done using the appropriate kits; however, there are times when kits are not available. Suspect chemical agents when you:

1. Hear someone yells "GAS, GAS, GAS."
2. See someone holding up his or her arms and moving arms inward/outward at the elbows.
3. Hear condition yellow or see a yellow flag (attack is probable).
4. Hear condition red or see a red flag (attack is imminent or in progress).
5. Hear condition black or see a black flag (NBC may be present).
6. Hear metal banging against metal.
7. Note slow low-flying aircraft, especially if there is a mist behind the plane.
8. See dead animals/birds/insects/people.
9. See fog. The most effective time to use chemical warfare agents is early in the morning, when the air is still, and patches of morning fog sit in low lying areas (this is when gasses/vapors stay around for a while, and chemical munitions experts wait for these climactic conditions).
10. Note tiny dots of liquid on surfaces (plants, vehicles, or anything else).
11. Hear or see munitions exploding (especially if they go thud instead of boom).
12. Hear a chemical agent alarm.
13. See other personnel wearing protective masks.

NATO NBC marking kit

Once the presence of contamination has been established the area should be marked with the NATO NBC marking kit (fig. 3–8). To mark the contamination, use the flag that identifies that type of contamination agent. See the following table for an explanation of the flags to use for marking contamination.

Agent	Letters on Flag	Flag Color
Nuclear	ATOM	White with black lettering
Biological	BIO	Blue with red lettering
Chemical	GAS	Yellow with red lettering

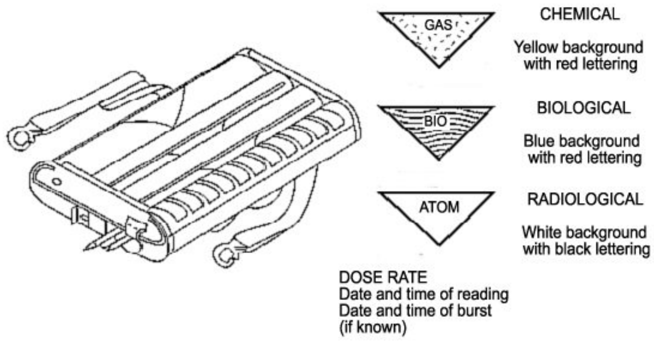


Figure 3–8. NATO NBC marking kit.

Reports of the contamination, the extent of the contamination, the type of agent identified, and the methods used for identifying the agent are forwarded to a proper authority by the most rapid means available through military channels.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

823. Detecting radiation

1. What does the acronym RADIAC represent?

2. What does REM stand for?

3. What does a Curie (Ci) unit measure?

4. What are the two different groups of RADIAC devices?

5. What are two types of total dose instruments?

6. What types of radiation is the ADM 300 capable of measuring?

824. Detecting biological agents

1. What clues may alert you of a biological warfare attack?

2. How can epidemics resulting from a biological warfare attack be prevented or controlled?

3. When should sampling be conducted?

4. How can biological warfare agents be detected?

825. Detecting chemical agents

1. Why shouldn't you use your senses to detect the presence of chemical agents?

2. What are the most widely available kits in the USAF?

3. What are the characteristics of the M90 chemical agent alarm?

4. The M256 kit will detect an agent within what timeframe?

5. What chemical agents will the M272 water test kit detect?

6. When does public health use the M272 water test kit?

7. What may cause false positives when using M9 tape?

8. What reasons may cause you to suspect chemical agents?

9. What are the three types of flags on the NATO NBC marking kit?

3–3. Personal Protective Equipment

Individual protection is everyone's responsibility. Knowing the proper use and care of your personal protective equipment will greatly reduce the possibility of you becoming a casualty in the event of an enemy attack or a peacetime incident.

826. Protective equipment for a nuclear environment

The best protection against a nuclear reaction or explosion is to put as much distance and shielding between you and the source of radiation as possible. There are specially designed protective equipment items for use during nuclear situations.

To protect yourself from alpha and beta particles during a peacetime nuclear situation, wear the anticontamination suit (ACS) (yellow suit), boots, gloves, and hood and the MCU–2P series mask. The suit prevents particles from entering the skin or wounds. However, if your mask is not worn properly, your efforts will be useless. The particles must not enter your respiratory system.

The steps to properly putting on the suit in a clean environment are:

1. Put the jumpsuit on legs first; then place the arms through the shirt portion.
2. Place firefighters boots on your feet, pulling pants legs over boots.
3. Tape the joints between the boots and pant legs with masking tape to prevent the entrance of the particles in the boots.
4. Place the white cotton gloves on your hands.
5. Tape the joints between the gloves, making sure the sleeves are over the gloves.
6. Ensure the hood is properly attached to the mask and then don the mask, making sure there is a good seal. (If you cannot get a good seal, you will be exposing yourself to the radiation particles.)
7. Tape the area where the hood meets the mask and suit.

The most important piece of personal protective equipment is your MCU–2P protective mask. The protective suit is the only good protection from radiation particles (e.g., alpha and beta), but does little to protect us from gamma and X-ray radiation. You can wear the chemical ground crew ensemble for the radiation particles also, but do not wear it for gamma radiation. Remember that it's best to put as much distance and shielding between you and the source of radiation as possible.

827. Protective measures against biological agents

Natural defenses of the body

Your best defense against BW agents is the natural resistance of your own body because your body has been fighting germs since you were born. If your resistance is high you do not catch cold easily and illnesses are often not as severe. The same holds true in a BW environment. Keep yourself in top physical condition. Physical exercise, adequate sleep, and proper diet are a strong defense against BW. A high standard of personal hygiene and good sanitation is insurance against the spread of diseases. Immunizations are added defenses.

Protective measures

Since biological warfare agents can enter the body through cuts and wounds and through ingestion and inhalation, you must be aware of the procedures for survival:

1. Report illness promptly.
2. Keep your personal hygiene and your living area clean and protect yourself from vectors. Ensure that you wash your hands before eating, after using the latrine, and bathe daily to reduce your chances of becoming exposed to biological agents. Unsanitary conditions could produce a breeding area for arthropods and rodents. The control of insects and rodents may be of increased importance following a biological attack since they may serve as a continuing source of infection. The duty uniform and gloves help protect against bites from vectors such as mosquitoes and ticks that may carry microorganisms. Clothing is kept buttoned, and trouser legs are tucked into the boots. Covering the skin reduces the possibility of the agent entering the body through cuts and scratches and also prevents disease-carrying insects from reaching the skin. Keep cuts and sores bandaged. Insect repellents and insecticides are effective against most disease-carrying insects. High standards of sanitation also improve the protection against some vectors.
3. Take all prescribed medications and immunizations. There is no first aid for illness caused by biological attack. If you become ill, seek medical attention as soon as possible.
4. When BW agents are suspected, keep your nose, mouth, and skin covered. Use your mask and other protective clothing or two layers of ordinary clothing to keep agents out of your body.
5. Protect your food and water. Bottled or canned foods are safe after a BW attack if the seals are not broken. Unprotected food may be contaminated. If in doubt, boiling for 15 minutes should kill most of the germs. However, some toxins are not affected by boiling.
6. Keep alert to any signs of BW attack. Watch for clues such as increased numbers on biostatistical reporting or increased epidemics.
7. Protect yourself from aerosols. The protective mask gives complete protection against aerosols of biological agents. It is not likely that biological agents will settle out from aerosols in any meaningful quantity and remain alive in soil or vegetation long enough to be a major problem. Where a biological munition is specially designed for ground contamination, marching troops may stir up contaminated dust that creates a secondary aerosol for some types of “dry” biological agents. Secondary aerosols will present a hazard to personnel in the immediate area, but are not considered a hazard of great military significance. In areas suspected of being contaminated, individuals should wear the protective mask and hood and decontaminate the clothing that was worn while in these areas.

828. Protective measures for chemical agents

Chemical agents may be released in the same manner as biological agents. The chemical agents can travel downwind and are affected by weather conditions. Most of the agents must enter the body before doing the greatest harm. The key to protective measures is to recognize the clues, try to get upwind, and use your protective mask and protective clothing.

Protective clothing

When you suspect a chemical attack, close your eyes and stop breathing until you put on your protective mask. If properly adjusted, your mask protects your face, eyes, and lungs from most known CW agents. Protective clothing helps to protect your skin against most agents. Impregnated clothing protects you against vapors and some blister agents, and provides very limited protection against liquid chemicals. Droplets of liquid blister agents or nerve agents can absorb through the impregnated clothes. Any part of your clothing that becomes contaminated by liquid agents must be ripped off immediately, and your skin must be decontaminated. When a chemical agent is present in liquid form, you are almost certain to get it on your shoes. Wear impermeable boots over your shoes to protect yourself from liquid chemical agents.

Mission oriented protective posture for public health personnel

Personnel receive MOPP-level (fig. 3–9) training from the base disaster preparedness flight. Currently, two types of MOPP exist—aircrew ensemble and ground crew ensemble (GCE). We will concentrate our attention on the GCE since this is what you'll wear while performing wartime patient decontamination.

MOPP Level 0	MOPP Level 1	MOPP Level 2	MOPP Level 3	MOPP Level 4	MOPP Level Alpha
WORN	WORN	WORN	WORN	WORN	WORN
Mask carrier Field Gear	Overgarment Mask carrier Field Gear	Footwear Covers Overgarment Mask carrier Field Gear	Mask / Hood Footwear Covers Overgarment Field Gear	Mask / Hood Footwear Covers Overgarment Field Gear Gloves	Mask / Hood Field Gear Gloves
AVAILABLE	CARRIED	CARRIED	CARRIED	CARRIED	CARRIED
IPE Issued, prepared, and available within 5 minutes	Footwear covers Mask / Hood Gloves	Mask / Hood Gloves	Gloves		Overgarment Footwear covers

Figure 3–9. Mission oriented protective posture levels.

The older style of the GCE was called the chemical protective overgarment (CPOG) and was a solid olive drab green in color. This style was estimated to provide 12 hours of protection in a chemical environment and was good for 14 days after being taken from the sealed wrapper. The CPOG is being quickly replaced by the newer battle dress overgarment (BDO). The BDO comes in two types of camouflage—woodland and desert. The BDO is estimated to provide 24 hours of protection in a chemical environment, and is good for 28 days after being taken from the sealed wrapping.

A new GCE, the Joint Service Lightweight Integrated Suit Technology (JSLIST), has been developed and is being procured by DOD. All GCEs contain absorbent charcoal impregnated between two layers of material. The exterior material does provide some water repellency (e.g., Scotchguard®); however, the garments are not considered waterproof. If you soak your GCE during patient decontamination operations, the liquid, along with the contaminants that were trapped in the charcoal, will seep through to your skin. To keep liquids from soaking our GCE, and to facilitate cleaning ourselves in order to lift or touch patients, we wear the M2 rubber aprons or rain pants with backward rain parka.

Impermeable gloves, boots, and mask with the hood are also worn with the GCE. The black, butyl rubber gloves come in three different thickness—7, 14, and 21 millimeters. We use the thicker of these for patient decontamination to avoid tears or rips during lifting and moving patients. The thinner gloves are worn when dexterity is necessary (e.g., when the medic on the decontamination team is observing a pulse when triaging patients). The green vinyl overboot is currently recommended for wear with the GCE. A new black vinyl overboot (BVO) is also available. The BVO has tabs on elastic eyelets to facilitate handling when wearing gloves.

NOTE: When MOPP is worn with an M2 apron, the WBGT scale is increased by 10°. For example, at 81°F the WBGT is a heat category I—basically pleasant with no mandatory work-rest cycles and only 1/2 quart per hour of water is recommended for consumption.

In contrast, 91°F is heat category V (the highest heat category)—the work-rest cycles are 20 minutes work, 40 minutes rest, and 2 quarts per hour of water are required for drinking.

Protective mask

The mask, when properly fitted and worn with the hood, provides protection against heavy concentrations of all known enemy chemical agents in vapor or aerosol form. Like air purifying industrial respirators, the masks filter the contaminated air to remove the agents, but they do not produce oxygen. The MCU–2/P mask does not protect against ammonia vapors or carbon monoxide. The MCU–2/P (fig. 3–10) protective mask is a standard field-protective mask. Regardless of the type of mask, you are responsible for proper care of the mask, as well as all other items of protective equipment issued to you. Inspect your mask frequently for damage and cleanliness. For complete instructions and specifications, see the appropriate technical order for the mask you have.

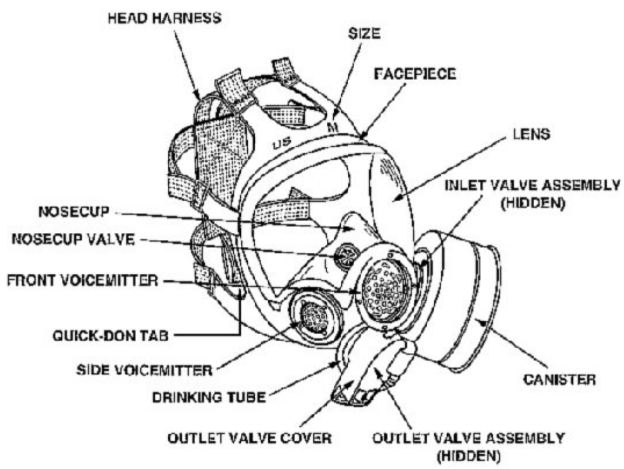


Figure 3–10. MCU–2P protective mask.

Unmasking procedures

After determining the absence of agents, two or three individuals unmask for five minutes, then remask and are examined for symptoms. If no symptoms appear, the remaining personnel may unmask safely. NOTE: Bright light will cause contraction of the pupils that could be erroneously interpreted as a nerve agent symptom.

As an emergency field procedure, when no detector kits are available, two or three individuals are selected to take a deep breath and hold it, break the seal on their masks, and keep their eyes wide open for 15 seconds. The individuals clear the masks, reestablish the seal, and wait for 10 minutes. If no symptoms appear after 10 minutes, the same individuals again break their seals, take two or three breaths, and clear and reseal their masks. After another 10-minute wait, if no symptoms develop, the same people unmask for five minutes and then remask. After 10 more minutes, if no symptoms have appeared, the remainder of the group can safely unmask. However, everyone should all remain alert for the appearance of any chemical symptoms.

Nerve agents antidotes

The nerve agent pyridostigmine pretreatment (NAPP) kit is the pretreatment for nerve agents. It consists of 21 blister pack tablets containing pyridostigmine bromide, a carbamate. Each tablet contains 30 mg each of pyridostigmine bromide tablets, a seven-day supply (take one every eight hours). The tablets are commonly referred to as "P-TABS." P-TABS are not an antidote; they are a pretreatment. Begin taking P-TABS only by order of your commander.

Nerve agent antidote (NAAK)/Mark I

The Mark I kit contains two auto-injectors—atropine (2 mg) and pralidoxime chloride (600 mg). Atropine is an anticholinergic compound (dries up secretions). Pralidoxime chloride is an oxime that breaks nerve agent-enzyme bond and restores normal activity of the cholinesterase. If an individual has nerve agent symptom, he or she should self-administer one Mark I. Remember that if you administer the kit, never use your own Mark I kit on a casualty, use his or hers.

To administer the NAAK, inject the Mark I into the lateral middle third of the thigh or upper lateral quarter of the buttocks (fig. 3–11). If symptoms persist after 10 minutes seek out a buddy to evaluate condition and administer the second Mark I. Then observe symptoms for another 10–15 minutes and administer the third if necessary. Medics never administer more than three Mark I's, unless directed by a physician. Generally, if you can walk, talk, or are oriented (i.e., know person, place, and time) no further treatment is necessary. If you administer three Mark I's, a convulsant antidote for nerve agents (CANA) must be given.

Convulsant antidote for nerve agents

The CANA is diazepam (Valium), a 10-mg auto-injector (fig. 3–12). CANA decreases convulsive activity and reduces brain damage. CANA is carried by each military person for buddy care, and it is only administered when a patient has received three Mark I's and symptoms are still present. In victims suffering from severe nerve agent intoxication, give three Mark I's, immediately followed by one CANA. If you can self-administer the CANA, you don't need it. CANA is for administration by buddy aid only.

After auto-injectors are administered, personnel should display the used injectors on the front shirt pocket of their outer garment. Push the needle through pocket flap and bend needle over to secure. This practice of hanging exposed needles on the overgarment does put medical personnel attending patients at risk of blood/body fluid exposure. Remember; always avoid contact with used needles. Injectors may not always be found on patients—troops may forget proper procedure or handling patients may bump off secured injectors. In such case, one indication of possible atropine injection is to look for a reddened traumatic injection site on the patient's leg during decon clothing removal process.

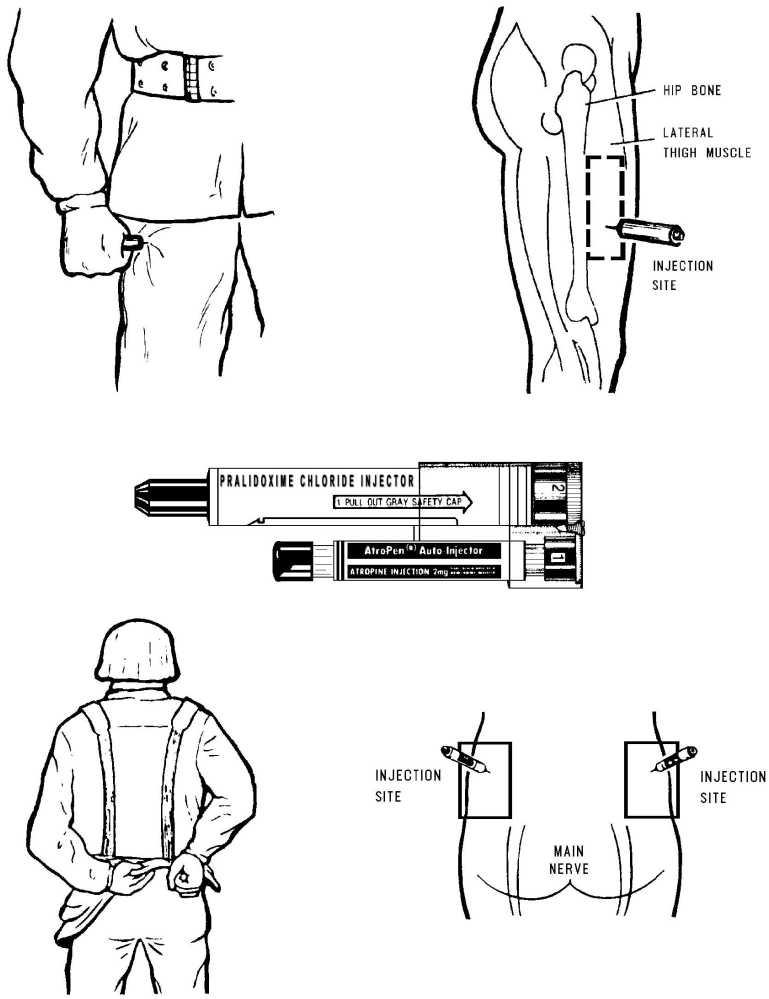


Figure 3–11. Auto-injectors.

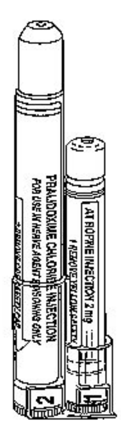


Figure 3–12. Convulsant antidote for nerve agents.

Personal decontamination

The need for speedy self-decontamination cannot be overemphasized because there are definite time limits when first aid becomes less effective. In most cases, you will not be able to immediately identify the chemical agent used in an attack.

M291 skin decontamination kit

The introduction of the M291 skin decontamination kit marks a new approach to skin decontamination. The M291 kit consists of six identical packets each containing a mixture of activated resins. This resin mixture both absorbs and neutralizes liquid chemical agents on the skin. The mixture consists of three resins—absorbent, sulfonic acid, and a hydroxylamine. The kit is also used for training purposes and standard issue is 20 M291 skin decon kits per box.

To decontaminate, remove the applicator pad and apply an even coating of resin powder while scrubbing the entire skin area suspected to be contaminated. One applicator pad will decontaminate both hands and face. A second pad will be required for the neck, throat, and ears. Ensure that the powder does not enter open wounds, the mouth, or eyes. The black resin powder residue will provide a visual confirmation of the thoroughness of application and will serve to alert the decontamination team of areas of suspected contamination.

M258 skin decontamination kit

The M258A1 skin decontamination kit (fig. 3–13) is currently the standard item for the removal and neutralization of liquid chemical agents on the skin. It contains three number 1 packets and three number 2 packets. Packet number 1 absorbs and neutralizes G-type nerve agents; whereas, packet number 2 absorbs and neutralizes the nerve agent VX and liquid mustard. Packet number 1 is applied for one full minute and followed up with packet number 2 for two full minutes. The decontamination solution is a skin burn hazard, and must be kept out of the eyes, mouth, and open wounds.

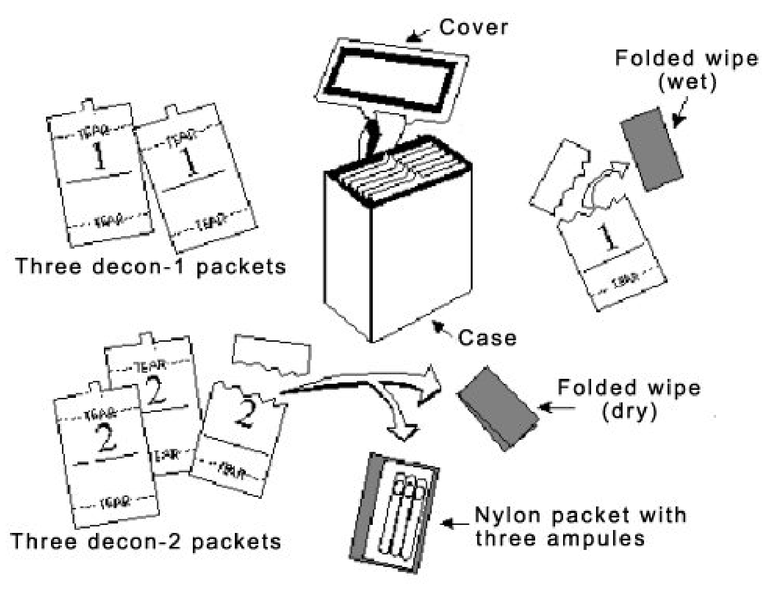


Figure 3–13. M258 skin decontamination kit.

A training M258A1 kit is available for use to avoid exposure to the caustic contents of the M258A1. The training aid and the decontamination kit are distinguished by packaging color. The M258A1 kit contains olive drab packets in an olive drab plastic case; the M258A1 training aid contains blue packets in a black plastic case. The trainer kit packets contain alcohol and water.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

826. Protective equipment for a nuclear environment

1. What will prevent entrance of radioactive particles into protective clothing?

2. What is the most important piece of protective clothing to wear when protecting yourself against alpha and beta particle radiation?

3. What is the best protection against a nuclear reaction or explosion (radiation)?

827. Protective measures against biological agents

1. What is your best defense against biological agents?

2. How can biological agents get into the body?

3. What are the protective measures that should be followed for survival after a biological attack?

828. Protective measures for chemical agents

1. What are the key things to remember in order to protect yourself against chemical agents?

2. What type of protective clothing will public health personnel wear while performing wartime patient decontamination?

3. In every case of a suspected chemical and biological attack, what should you do until you can put on your protective mask?

4. What should you do if a liquid chemical agent is spilled on permeable protective clothing?

5. How many degrees does the temperature increase while wearing the M2 apron for decontamination procedures?

6. When are pyridostigmine bromide pills to be taken for nerve agent pretreatment?

7. Where are auto-injectors placed once injected?

8. When is CANA administered?

9. How long do you wait before administering the second and third Mark I's?

3–4. NBC Decontamination

Decontamination means the reduction or neutralization of contamination. The goal is to remove all contaminants that would harm personnel. Realistically, we can only remove contamination down to lower or safer levels. To expect complete decontamination of many NBC agents is unrealistic. Decontamination is essential to prevent further exposure of patients, medical assets, and subsistence. Personal decontamination is decontamination of self. Casualty decontamination refers to patient decontamination, while personnel decontamination usually refers to decontamination of noncasualties.

829. Eliminating contaminants

Types of decontaminants

Chlorine solutions

Chlorine solutions are the preferred method of decontamination for mass patient decontamination operations. By liberating chlorine on contact, chlorine solutions change nerve and blister agents to less toxic chemicals. As with all liquid decontamination solutions, avoid spreading contaminants by minimizing runoff. Use damp (not dripping wet) gauze to wipe (not scrub) contaminated skin, and avoid contact with eyes. The chlorine in the solutions will gas off and be neutralized by organic materials and the chemical agents. Change the solutions frequently to ensure you are maintaining the proper chlorine concentrations. Use the chlorine solution-measuring device, NSN 4610–00–205–0810, to prepare the solutions to the proper concentrations.

Two different concentrations of chlorine (CaCl) solution are used in the patient decontamination procedure. A 0.5 percent chlorine solution is used for all skin decontamination. A 5 percent chlorine solution is used to decontaminate the casualty's protective mask and hood; scissors, toxicological agent protective (TAP) aprons, and gloves of decontamination team personnel; and litters. The chlorine solutions are placed in the buckets for use. Buckets should be distinctly marked to indicate 0.5 percent and 5 percent solutions. It may be much easier to differentiate the two if the 0.5 percent solution is marked "skin" and the 5 percent solution is marked "equipment."

70 percent calcium hypochlorite (CaCl powder)

The only chlorine stocked in with the decon team equipment package is the 70 percent calcium hypochlorite (CaCl).

5 percent sodium hypochlorite (chloral)

If a shortage of chlorine occurs, regular household bleach can be procured and utilized. Household bleach contains a 5 percent chlorine solution and should be used undiluted when decontaminating equipment. For skin decontamination, one-half gallon in five gallons of water yields a 0.5 percent solution.

Soapy water

Mixtures are effective as long as suds are maintained. Soap lowers the surface tension of water, thus increasing the wetting power and helping the water to loosen and carry off dirt and grease. Mustard agents are emulsified by this process, but they are not neutralized. Nerve agents are partially neutralized. As with all liquid decontamination solutions, avoid spreading contaminants by minimizing runoff. Use damp (not dripping wet) gauze to wipe contaminated skin.

Sodium bicarbonate (baking soda/bicarbonate of soda)

Sodium bicarbonate destroys G agents by hastening their hydrolysis. It does not destroy nerve or blister agents as rapidly as calcium hypochlorite solution. Avoid contact with eyes. Prepare a 5 percent solution by mixing one pound of baking soda to five gallons of warm water. As with all liquid decontamination solutions, avoid spreading contaminants by minimizing runoff. Use damp (not dripping wet) gauze to wipe (not scrub) contaminated skin.

Diatomaceous earth

Mix three parts diatomaceous earth with one part CaCl. The mixture absorbs liquid agent from aprons, gloves and, to a lesser degree, skin. Avoid contact with eyes, mouth, and open wounds. Diatomaceous earth is preferred over wet solutions for removing liquid blister agent from equipment because liquid CW agents are generally hydrolyzed in water but not neutralized and can therefore be spread in wet solutions. Using diatomaceous earth can be more time-consuming than using wet solutions because all visible dust must be brushed off the patient. Apply by sprinkling it onto the affected area and gently brushing it off after a one-minute contact time. Rinsing with a minimal amount of soapy water can aid removal of dust from surfaces. Research data indicate that once an agent is absorbed by diatomaceous earth, it no longer presents a skin contact hazard. However, the agent may slowly evolve out of the diatomaceous earth and can present a vapor hazard over time. The agent may also be released if the used diatomaceous earth becomes wet. NOTE: Diatomaceous earth is an inhalation hazard and should not be used during training. Sand may be used as a substitute during training.

Methods of decontamination

Brushing

Brushing will usually remove most of the radiological dust and can often reduce the contamination below the permissible level. If thorough brushing does not reduce the radioactive intensity to the desired level, then wash the item, if possible. Try to always brush contaminated items from the upwind side. Keeping the area moist may help reduce airborne dust. Always monitor equipment and individuals at completion of work.

Vacuuming

Another method used for removing dry contaminants is vacuuming. Use a vacuum that will contain contaminants and not blow them into the air. A high-efficiency particulate air filter (HEPA) vacuum will help prevent contamination spread through vacuum exhaust. The contaminants and the bag must be disposed of properly when decontamination is complete.

Weathering

When other methods fail, and the item is too valuable to be buried or destroyed, decontaminate by weathering (aging). Mark the item to indicate it is radioactive, and then take it to a place designed for aging radioactive material. This method is not used for patients or personnel. In wartime, use any method available to remove contamination. In some cases the methods may be combined to effectively remove contamination. One factor to consider when selecting a form of decontamination is the type of facility or surroundings you have available for decontamination.

830. Patient decontamination

Public health personnel manage and work on the patient decontamination team, monitoring and decontaminating patients prior to entering the medical facility. While on the patient decontamination team, public health must be ready to decontaminate patients, medical personnel, medical equipment, and medical vehicles. The purpose of patient decontamination is to:

1. Remove NBC contaminants from patients without further contaminating the patient. Remember that MOPP gear on a patient may only be contaminated on the "outside." Our challenge is to remove the contaminated MOPP without spreading the contamination "inside" or subsequently onto the patient.
2. Remove NBC contaminants from patients without spreading contamination to patient decon team members.
3. Prevent contamination from spreading into the medical facility.
4. Control contaminated runoff.

Decontamination causes a delay in definitive medical treatment that could prove critical in some cases. Therefore, only those casualties that are confirmed or suspected contaminated should be subjected to the decontamination process.

The bottom line is we must remove contaminants from patients, without spreading them, in the quickest manner possible that enables prompt medical treatment. This is the premise of this section.

Patient decontamination team composition

Medical personnel are assigned to the 19-person patient decon team (UTC FFGLB) by the MTF commander. Normally two 19-person patient decon teams will deploy together with one decontamination equipment package (UTC FFGLA, discussed later). The concept is to rotate the two 19-person teams on the one-equipment package. Assignment to the patient decon team is considered a war contingency tasking, not an extra duty or a detail.

The standard decon team is composed of 19 members:

POSITION	AFSC	QUANTITY
Health SVC MGT JNMN	4A051	4
Medical Logistics JNMN	4A151	1
Public Health CFMN	4E071	1
Public Health JNMN	4E051	3
Medical Service CFMN	4N071	2
Medical Service JNMN	4N051	2
Dental Asst JNMN	4Y051	6

Decon team equipment and supplies

Equipment and supplies needed by MTFs with contingency tasking for a patient decontamination equipment assemblage (UTC FFGLA) are listed in AS 902A, Appendix B, at the end of this volume.

Personal protective equipment quantities in AS 902A outfit 38 decon-team members. (In addition to these quantities, GCEs are issued as mobility gear to each person upon deployment to a high threat area). Supplies are estimated to perform complete body skin decontamination of 500 casualties.

Patient decontamination facility

Decon facility requirements include easy access to water (free of NBC contaminants), electric light, heat or air conditioning (in extremely hot or cold environments), drainage away from the decon facility and MTF, two shuffle pits (4" × 2' box, 4" deep, with an attached bottom), and shelving (to hold clean supplies and decontamination agent ingredients). Patient decontamination does not have to be conducted inside a facility or tent. However, a roof of some kind is desired to protect equipment and GCEs from rainwater (which can compromise suits and filters) and to provide shade. Complete enclosure in a facility or tent is needed if heat or air conditioning is desired and to protect equipment from weather, dirt, and pilferage. Obviously, vapor concentrations will be greater in an enclosed facility. The impact of this vapor concentration on patient decontamination is difficult to predict because it will depend on the agent, quantity present, air temperature, decontamination solution used, etc. Although decon team members are protected from chemical agent vapors, patients removed from their GCEs may be compromised. It's desirable to minimize vapor buildup in the facility by maximizing ventilation, frequently removing bags of contaminated waste materials from the interior of the facility, and rinsing of the facility floor (if possible). Increased ventilation can be accomplished by opening doors and windows, using fans or ECUs, rolling up tent sides, etc. Another way to reduce vapors inside the facility is to operate station 1 (clothing removal) outside the entrance. Since 90 percent of the agent will be removed with the clothing, most of the agent will never enter the enclosed area of the facility when using this option. Each decon team chief must decide if local circumstances dictate that temperature control or other factors take precedence over potential vapor buildup.

The interior of the decon facility is designed to become progressively cleaner from entrance to exit. In figure 3–14 you can see the progress for both ambulatory and litter patients. This is accomplished by using gently sloped terrain or floor drains (where available), a series of shuffle pits, and a wall (to restrict vapor movement and splashing) between the wash and remonitor stages. Stations 1 and 2 are liquid hazard areas (LHA). Station 3 is a vapor hazard area (VHA). MOPP 4 is required in the LHA and VHA.

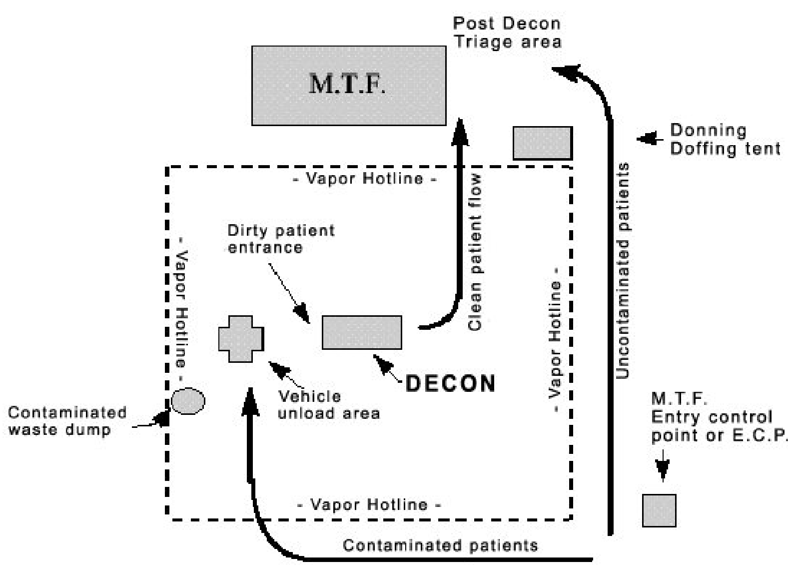


Figure 3–14. Decontamination station layout.

The decon team operates within the MTF security (fig. 3–15). The decon facility will be at least 250 ft downwind of the MTF, and be situated so arriving vehicles/casualties can reach it without approaching the MTF. A vapor hazard hotline, which separates the vapor hazard area from the toxic free area, is established halfway between these facilities. The 250 ft distance between the decon facility and MTF permits the movement of the liquid and/or vapor hazard lines if areas on the clean side become contaminated and prevents the creation of an inhalation hazard to the MTF from shifting wind directions. Where hardened facilities are used by MTFs, the decon facility can be safely located in the same building provided air and water flow patterns inhibit vapor and liquid transfer to the treatment areas.

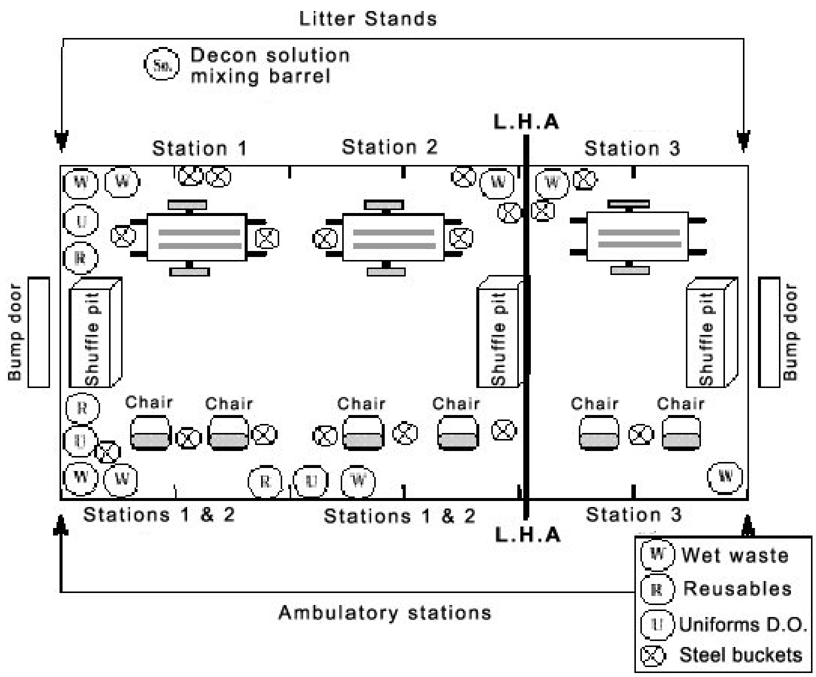


Figure 3–15. MTF/decontamination facility placement.

Moving patients

Carrying litters over this 250-ft distance would slow the decontamination process and rapidly fatigue personnel. Therefore, wheeled litter carriers (fig. 3–16) are included on the decon team equipment list and can be used for this purpose. Gently sloping terrain and soil conditions which permit drainage from beneath the decon facility are also needed.

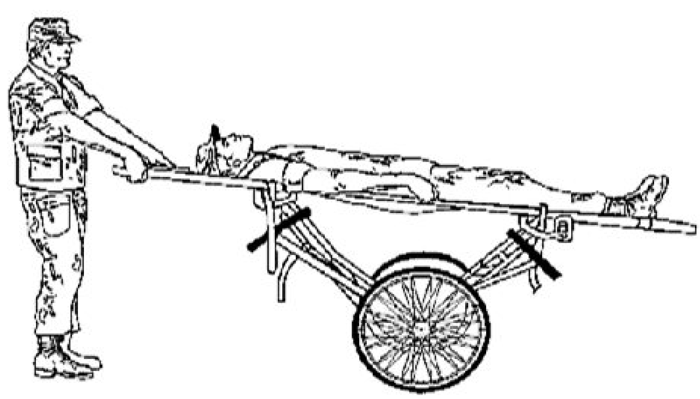


Figure 3–16. Wheeled litter carrier.

Marking boundaries

M9 detection paper will be used to mark areas and facilities around the decon team and medical compound to detect liquid agent contamination and to ensure the integrity of the hotline.

Shuffle pits

A shuffle pit should be placed at the decon facility entrance. Also, position a shuffle pit between stations 2 and 3. This second pit marks the liquid hazard line. Use one part calcium hypochlorite (CaCl) to three parts of diatomaceous earth or any other available dry chlorine/earth mixture as filler.

Water for decontaminating

Water bladders and a pump enable the decon facility to store clean water and to pump it directly into the decontamination solution receptacles (buckets or trash cans).

Processing patients

When chemical weapons have been used against friendly forces in the theater of operations, the decon team is activated. All arriving casualties are then directed to stop at the MTF entry control point (ECP). At the ECP the determination of whether or not to decontaminate is needed (e.g., by using M8 paper/M9 tape, or the CAM). The decision to decontaminate a patient should be based on more than injuries and symptoms. Many conventional weapons can cause "chemical-warfare agent-like" symptoms. These include napalm (e.g., burns/blisters); incendiaries (e.g., burns/blisters, and incidental toxic fumes or oxygen deficiency); obscurants, smokes, and riot control agents (e.g., nausea, coughing, and chemical burns/blisters in high doses). Guidance on the management of these and other nonchemical warfare agent casualties can be found in AFJAM 44-149, *Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries*, and AFR 355-7, *Potential Military Chemical/Biological Agents and Compounds*. Casualties not contaminated with NBC contaminants are directed around the decon facility to the MTF. Casualties confirmed or suspected to be contaminated are directed to the decon facility.

Triaging patients

To arrest the spread of contaminant on the patient and prevent further contamination of medical personnel and assets, decontamination of patients is accomplished prior to the delivery of definitive medical care. Contaminated patients at the patient decon site also need medical care. An emergency medical treatment team (the four medics assigned to your team) should perform life-saving medical treatment prior to, and during decontamination. The senior emergency medical technician (EMT) will also conduct predecontamination triage. Unless otherwise instructed by the MTF commander, patients will be processed through the decontamination facility in the following priority:

1. Immediate.
2. Minimal.
3. Delayed.
4. Expectant.

Treatment at the emergency medical treatment station includes administration of auto-injectors and diazepam, application of pressure dressings, establishing a patent airway, and starting an IV infusion. The mask can be removed from the patient for emergency airway management or resuscitation. If immediate clearing of the airway must be done at this point to save a life, the airway is cleared, and the mask replaced. The resuscitation device individual chemical (RDIC) must be used to prevent exposing the patient to vapor hazards. The RDIC is a bag valve mask with an M2 canister (like the one on your MCU–2P) attached that can provide filtered air to patients experiencing airway problems.

The patient decontamination process normally starts after the emergency medical team stabilizes patients and before they are transferred to the medical facility for definitive care. However, in casualties contaminated with only nuclear fallout, they may be sent directly to the MTF for life-saving treatment prior to decontamination. Nuclear fallout presents less of an immediate hazard to medical personnel than does a persistent chemical agent.

Wound and bandage management

Emergency medical treatment members will attempt to process contaminated casualties without interfering with bandages, splints, and tourniquets by cutting around them. However, if there is any doubt about contamination of the items or if they obstruct or inhibit skin decontamination, the most qualified medical technician assigned to the decon team will perform these tasks. Decontamination of wounds and mucous membranes (when contaminated) is primarily done by irrigation. Irrigation fluids can spread contaminants and must be controlled.

Decontamination process

Begin the decontamination process after the medics have stabilized the patient. It is best to utilize a systematic assembly line process. The process has the advantage of employing separate people for successively cleaner tasks. The tasks are organized as:

- Station 1—cut and remove clothes.
- Station 2—wash skin.
- Station 3—remonitor and transfer to MTF.

Other advantages of this process are:

1. Because of the assembly line process, each member does fewer tasks. Therefore, the process is more likely to flow smoothly and members are less likely to accidentally skip a step.
2. Traffic flow within the decon facility is smooth because station 1 members don't operate in the same space as station 2 members, etc.
3. This system can simultaneously process between 4–5 litter and 6–7 ambulatory patients in an hour, depending on the level and type of contaminant.

Four people man the ambulatory line (three at stations 1 and 2, and one at station 3). Twelve people man the litter line (four at each station). The four EMTs work where-ever they're needed—to perform triage, assist in patient movement, or perform lifesaving medical procedures. The decon team chief moves freely between these lines. NOTE: Work can be done simultaneously with two members on either side of the patient at stations 1 and 2. Clothing removal is expected to remove over 90 percent of contaminants.

Station 1, litter patient clothing removal station

This station has four people. The following information includes the steps and procedures to follow at the patient clothing removal station:

1. Carry the litter patient from predecontamination triage/emergency treatment area to station 1–Begin by removing litter straps and placing them into the contaminated barrel. Remove any load-bearing equipment that the patient may be carrying, and drop into contaminated barrel. Decontaminate hood, mask, and boots with 5 percent chlorine solution.
2. Remove hood: MCU–2P and/or M/40–Wash scissors prior to removing the hood. Release or cut hood shoulder straps. Cut neck cord (one person). Cut up from bottom front of hood, through the elastic line below voice emitter. Cut the temple straps of the hood, NOT the mask (one person). Roll left and right sides of the hood away from the patient's head (two person).

3. Remove overgarment jacket–Wash cutters or scissors. One person starts to cut at top of the jacket on the right side of the patient's button line and works downward to the bottom of the jacket. Wash cutters or scissors again. Then, two team members each grasp a sleeve at the wrist, pull the arm out (away from the patient) and cut from the groove in the jacket collar area down to the cuff of the sleeve. Personnel working in a contaminated area will have more contamination on their cuffs (near the glove) than at the collar (that was covered by the hood). Cutting up from the cuff could spread contamination from a dirty area to a clean area (this could be critical at the jugular vein area). Roll chest sections inside out toward the patient's sides and tuck these rolls between arm and chest.
4. Remove outer gloves–Wash your gloves. Lift patient's arm by grasping outer glove. Pull the glove away from the patient over the sides of the litter, rolling the cuff over the fingers, turning the glove inside out. Wash your gloves again. Being careful to only touch the patients' gloved hands, lower the arms across the chest. The goal is to avoid touching the potentially contaminated trousers with the patient's inner gloves and unprotected wrists. Drop gloves into the contaminated barrel. Do not remove inner white gloves.
5. Remove overgarment trouser–Position a person at patient's right and left legs and spread the legs slightly. Wash cutters. Cut from waist to cuff (both legs can be cut at once). Fold the waist front between legs and roll fabric away inside out toward the patient's side. Cut clothing around tourniquets. CAUTION: Bandages required for severe bleeding are treated like tourniquets.
6. Remove overboots–Position two people, one at each foot. Wash your gloves. Cut or unfasten tabs. Place overboots in contaminated barrel. The patient should now be in BDUs, with or without blouse. Wash each other's M2 aprons and gloves prior to proceeding to next step.
7. Remove BDU shirt–Wash cutters. One person starts to cut at the bottom of the shirt on the right side of the patient's buttonline and works upward to the neckline. Cutting off buttons instead of making a long cut up the buttonline is quicker. Wash cutters again. Both team members grasp a sleeve at the wrist, pull the arm out (away from the patient) and cut the wrist area of sleeve along the inseam up to armpit, and then to the neck area. Roll chest sections inside out toward the patient's sides and tuck these rolls between arm and chest.
8. Remove BDU trousers–Position a person at patient's right and left legs and spread the legs slightly. Wash cutters. Unbuckle belt. Cut from waist to ankle (both legs can be cut at once). Fold the waist front between legs and roll fabric away from patient's legs.
9. Remove combat boots–Position a person at each foot. Cut boot laces along the tongue. Pull boot downward and toward you until removed. As combat boot is removed, slide impermeable barrier (plastic bag, chuck, etc.) under foot so that the clean foot is not dropped on a contaminated litter. Drop boot in contaminated barrel.
10. Remove underwear–Wash cutters. Cut at both side seams and fold down, inside out. Put underwear in contaminated barrel.
11. Remove brassiere– Wash scissors. Cut both shoulder straps. Cut between cups and both shoulder straps where they attach to cups, lay straps back off shoulders, and pull cups to sides. Put underwear in contaminated barrel.
12. Remove socks–Wash your gloves. Grasp sock at top and pull over foot, turning sock inside out. As sock is removed, slide an impermeable barrier (plastic bag, chuck, etc.) so that the clean foot inside is not dropped on a contaminated litter below.
13. Remove inner gloves–Wash your gloves. Grasp glove at wrist and pull over hand, turning inside out.
14. Decontamination/contamination avoidance–Wash each team member's aprons and gloves with 5 percent chlorine solution. Perform three-man lift of patient (if the patient has a spinal

injury requiring additional in-line support or if the patient is extremely large; then use a four-man lift). Fourth member scoops cut clothing off litter and drops into barrel. He or she then takes litter off the stationary-wheeled litter carrier and passes back out the dirty door (decon facility entrance), and then places a clean mesh litter on the stationary-wheeled litter carrier. Use wheeled litter carrier instead of litter stands for stations 1 and 2. Patient is lowered onto mesh litter. Wash gloves and aprons. Get the next patient.

Station 2, decontamination of litter patient

A minimum of four people must be at this station. One person is needed to coordinate the process and three people for lifting and rotating the patient. After patient is received from station 1, perform decontamination by doing the following steps and procedures:

1. Wash patient and litter with .5 percent chlorine solution so that the litter is as clean as the patient. Copious amounts of water should be used if available to ensure patient, litter, and cart are adequately decontaminated.
2. Using a modified log roll, roll patient side to side on litter to facilitate thorough cleaning of patient’s backside and cleaning of mesh litter.
3. If C-spine is a consideration, follow procedures similar to those at station 1.
4. When patient and litter are decontaminated, pass him or her to station 3. Ensure litter cart handles are cleaned before transfer.
5. Wash gloves and aprons.
6. Hand patient over to station 3. Proceed to the next patient.

Station 3, patient monitoring and transfer to medical facility

A minimum of four people are required in this station—one to coordinate the monitoring and three to assist with receiving and moving the patient. The following steps are performed at this station:

1. Remonitor patient, mask, litter, and cart. Pass back to station 2 if dirty. If clean, cover patient with sheet until they can be clothed again.
2. Roll patient and clean litter out of decon area to “vapor hotline” for pickup by medical personnel.
3. Masks are removed by decon team member, placed inside a clean ziplock bag, and sent with the patient to the MTF.
4. Receive next patient from station 2.

Station 3 will also hand “clean” materials and supplies across to station 2 as needed.

NOTE: AS 902A should supply the decon team for 500 patients, but only 12 decontaminable (mesh) litters are in the supplies. The concept is to transfer patients off the mesh litters onto ER gurneys, then return the mesh litters to the decon team area for reuse. The turnaround time on the mesh litters should be minimal; therefore 12 mesh litters should be sufficient.

Decontaminating ambulatory patients

While decontaminating ambulatory patients direct the patients to remove as much of their contaminated clothing as they are physically capable of doing. Directing the patients to remove their own clothing allows patient decontamination team members to practice contamination avoidance, a critical skill when performing patient decontamination at all phases of the decontamination process.

If the patient is unable to remove his or her own clothing, follow the steps and procedures listed below:

1. Hood removal and decontamination–Decontaminate protective hood, mask, and boots with 5 percent chlorine solution. Wash/wipe external parts of mask. Roll hood over top of mask. Wipe exposed areas of patient's face including the chin, neck, and back of ears.
2. Removal of overgarment jacket (one person)–Instruct patient to clench his or her fists, then stand with arms held down and extended backward at a 30 degree angle. Stand in front of patient. Unsnap or unvelcro jacket front flap. Cut or untie bottom string. Unzip jacket front. Move to the rear of the patient. If no splints, bandages, or tourniquets are present, grasp jacket at collar. Peel jacket off shoulders at a 30-degree angle, down and away from the patient (avoid rapid or sharp jerks to avoid spread of contamination). Smoothly pull the inside of sleeves over the patient's wrists and hands. If splints, bandages, or tourniquets are present, wash scissors and cut around all splints, bandages, and tourniquets.
3. Removal of overgarment trousers (1–2 people)–Cut around all splints, bandages and tourniquets. Make two cuts from the outside seam, waist to the ankle. Let the trousers drop, pull away from patient's feet, and dispose of trousers.
4. Removal of overboots, green vinyl or lace-up boots overboots–Wash your gloves. Green vinyl overboots—cut or unfasten tabs. Lace up overboots—cut or untie laces, fold lacing eyelets outward, grasp heel and pull towards you until removed. Place overboots in contaminated barrel. Wash your gloves.
5. Removal of outer gloves (1–2 people)–Wash your gloves using thumbs and forefingers of both hands. Have patient unclench his or her hands. Grasp the heel of patient's glove. Peel glove(s) off with a smooth downward motion. (If one person, repeat on opposite side). Drop gloves in contaminated barrel.
6. Removal of glove liners. May actually be in step 5 if outer gloves were torn or damaged–Patient should remove the liners since this will reduce the possibility of spreading contamination. Tell patient to grasp heel of glove with thumb and forefinger. Without touching exposed skin, peel liner downward and off (away from body). Drop in plastic-lined can for contaminated disposal, and then remove and dispose the remaining liner in the same manner.
7. Removal of BDUs if contamination of BDUs is suspected or confirmed–In the same manner as the removal of overgarments in steps 2 and 3.
8. Gross patient decontamination–Wash contaminated areas of the body with a .5 percent chlorine solution, paying extra attention to clean the hairier parts of the body. After decontamination, monitor the patient and rewash any areas that may still be contaminated.

The fundamentals of patient decontamination are to remove the outer and otherwise exposed layers of clothes and wash, but do not rub or scrub exposed skin with gauze saturated with .5 percent chlorine solution. Pay particular attention to places where particles can be trapped (e.g., hair, armpits, ears, nostrils, between fingers and toes, etc.). Wash each area that was not protected by clothing/hood/gloves for one minute using wet gauze, replacing the gauze frequently. Don't use dripping-wet gauze because this and indiscriminate washing of unexposed skin surfaces may spread contamination.

Washing the gloves and cutting instruments

The importance of washing gloves and cutting instruments cannot be overemphasized. Washing must be more than just dipping you fingertips and cutting instruments into the decontamination solution. If a liquid decontamination solution is used, the cutting instruments and fingers on your gloves must be agitated while submerged. If Diatomaceous earth is used, it must be rinsed off (dip and agitate) in a chlorine solution before next use to remove all dust. Rescue knives are fast and can be less tiresome for cutters. If you leave your rescue knives or other cutting instruments wet or unprotected, the blades rust almost overnight. Keep an adequate supply of replacement blades available.

Removing personal items from patients

Removing personal items from the clothing of patients during decontamination operations would ensure the items were kept segregated from those belonging to other patients. However, this may slow the process, and should only be done when patient rates are low. During patient surges, and when the decon team chief directs, personal items will be collected from contaminated clothing after all patients have been processed. To do this process, follow the procedures listed below:

1. When collecting personal items from contaminated clothing, use one plastic bag to hold all of the items from each piece of clothing.
2. Decontaminate the items while maintaining this grouping.
3. Transfer the group to a clean bag.
4. The bags will be given to the MTF administrator for safe-keeping and disposition.
5. The decon team chief will personally ensure the integrity of this operation. The contents of each bag can then be examined for personal information or can be identified by patients.

Correctly closing down decontamination facilities

Before leaving the decontamination facility for temporary termination of operations, the patient decontamination team members must decontaminate each other. Each team member must be decontaminated in the same way as an ambulatory patient would be decontaminated. Team members must make sure the following steps are done:

1. Completely decontaminate his or her gloves, aprons, and gloves again.
2. Remove aprons and hang them up to avoid recontamination.
3. Decontaminate his or her overboot tops and gloves.
4. Monitor the entire ensemble for contamination and remove contaminated items.
5. Decontaminate his or her boot soles in shuffle pit.
6. Don’t remove the mask until after crossing vapor hazard hot line.

Patient decontamination team member tent

A two-section tent is used by the patient decontamination team as staging and storage areas. It is located at the vapor hot line between the MTF and the decontamination facility. The decontamination team will need an area to perform their shift change and resupply procedures without the support of the MTF. This tent is also used to allow patient decontamination team members to put on and take off their protective equipment prior to and after each shift. A tent is necessary to provide protection to the team members and supplies from the elements and pilferage.

Runoff control

Waste-water from the decontamination site should be considered hazardous. During the actual operation of saving life/limb, runoff control may seem secondary. However, we must keep runoff from spreading, especially to our water table. Figure 3–17 illustrates one example of controlling runoff for a patient decontamination facility. There is no hard and fast rule for runoff control, but there are some suggested ideas. In Desert Shield/Storm runoff control ranged from poured concrete slab, sloped, and sealed to drain into a concrete pit, to wood pallets. The pallets allowed drainage underneath, only to be moved later with the plan of digging up and canning the contaminated earth. Realistically, we should strive for a floor between the ideal (concrete flooring) and some makeshift flooring (e.g., wooden pallets and sloped floors). The bottom line is we need some kind of drainage control system; however, each scenario will be different. Use your medical intelligence to find out what kind of soil (e.g., rocky, sandy, frozen, high water table) you will be dealing with at your deployment site, and preplan your runoff control accordingly.

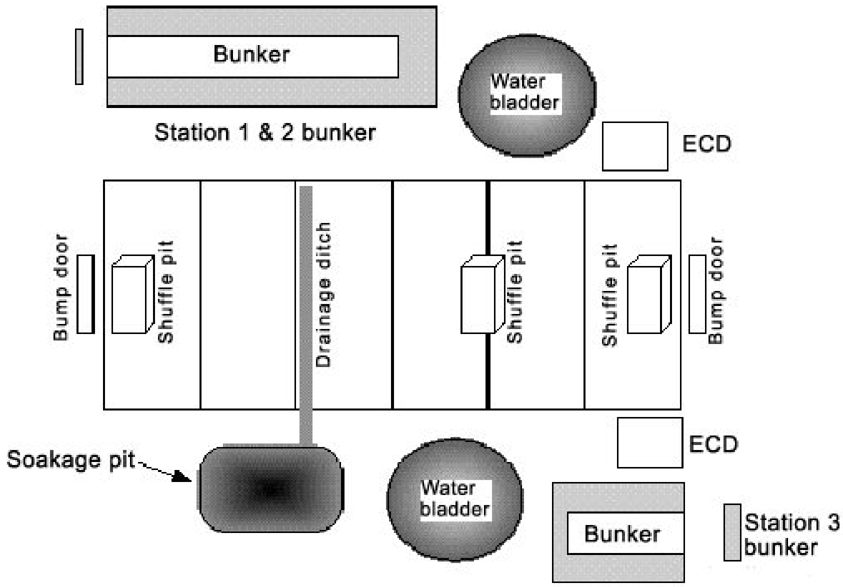


Figure 3–17. Patient decontamination runoff control.

Chemically hardened air transportable hospital (CHATH)

The CHATH is an air transportable hospital (ATH) designed to operate in a contaminated environment. NBC filtered ECUs create a positive pressure "clean" environment inside the facility, allowing medical personnel to operate in a shirt-sleeve environment. As you can see from figure 3–18, the patent decontamination site is literally attached to the emergency room entrance. Performing patient decontamination at the CHATH would be the only time that we would remove patients BDO protection in a contaminated environment.

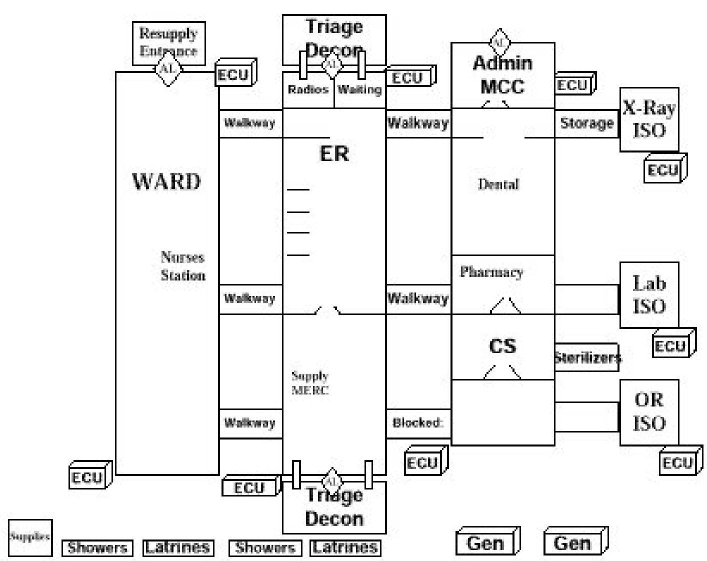


Figure 3–18. Chemically hardened air transportable hospital.

831. Decontaminating equipment

Many times water cannot be used to decontaminate equipment, especially electrical equipment. Time and resources should not be spent cleaning the facility or equipment unless it is necessary for their continued use or for the safety of other medical assets. One should question the decontaminability of items made of absorbent material like canvas litters or tents. In some cases, it will be impossible to immediately remove contaminants from absorbent materials. Immediate destruction and replacement, or waiting for time/aging may be the only way to continue operations. Floors and walls may accumulate enough contamination to be hazardous to patients. If time and resources permit, wash the floor when radiation levels reach three times outdoor background (naturally occurring level of radiation) or when chemical agent monitoring indicates the presence of free liquid agent. Water interferes with beta monitoring, so monitor the driest yet most contaminated areas. Contaminated supplies and the contents of contaminated material barrels that will not be salvaged should be bagged, sealed with tape, and taken to a disposal site downwind from the decon site.

Decontamination methods for various equipment items are shown in the following table. This table not only identifies the decontaminating agents and the surfaces for which each is suitable, but also explains the action of each agent, the technique for using the various methods, and the advantages and disadvantages of each.

Summary of Surface Decontamination

Method	Surfaces	Action	Technique	Advantages	Disadvantages
Abrasion	Nonporous surfaces.	Surface removal.	Use conventional procedures, but keep surface damp to avoid dust hazard.	Activity may be reduced to as low a level as may be desired.	Impractical for porous surfaces because of surface penetration by moisture.
Wet sand-blasting	Nonporous surfaces.		Wet sandblasting is most practical on large surface areas. Collect used abrasive.		Contamination spread over area must be recovered.
Vacuum blasting	Porous and nonporous surfaces.	Abrasion with controlled removal by vacuum suction.	Hold tool flush to surface to prevent escape of contamination.	Controlled disposal.	Contamination of equipment.
Vacuum cleaning	Dry contam-inated surfaces.	Removal of contaminated dust by suction	Use conventional vacuum technique with efficient filter.	Good on dry porous surfaces. Avoids water reactions.	All dust must be filtered out of exhaust. Machine is contaminated.

Summary of Surface Decontamination					
Method	**Surfaces**	**Action**	**Technique**	**Advantages**	**Disadvantages**
Water	All nonporous surfaces (metal, paint, plastic, etc.). Not suitable for porous materials, such as wood, concrete, canvas, etc.	Solution and erosion.	Use gross decontamination employing water shot from high-pressure hoses. Work from top to bottom to avoid recontamination; from upwind to avoid spray. 15 to 20 ft from the surface should be hosed at an incident angle of 30 to 45 degrees. Determine cleaning rate experimentally if possible. Otherwise use a rate of 4 square feet per minute.	All water equipment may be utilized. Allows operation to be carried out from a distance. Contamination may be reduced by 50%. Water solutions of other decontaminating agents may utilize water equipment.	Drainage must be controlled. Porous materials will absorb contaminants. Oiled surfaces cannot be decontaminated. Not applicable on dry contaminated surfaces (use vacuum). Spray will be contaminated.
Detergents	Nonporous surfaces (especially painted or oiled surfaces).	Solution and erosion.	Work from top to bottom and from upwind. Clean surface at a rate of 4 square feet per minute. The cleaning efficiency of steam may be greatly increased by using detergents.	Steam reduces contamination by approximately 90% on painted surfaces.	Steam subject to same limitations as water. Spray hazard makes the wearing of waterproof outfits necessary.
Complexing Agents Oxalates Carbonates Citrates	Nonporous surfaces (especially unweathered surfaces; i.e., no rust or calcareous growth).	Forms soluble complexes with contaminated material.	Solution should contain 3% (by weight) of agent. Spray surface with solution. Keep surface moist for 30 minutes by spraying with solution periodically. After allotted time, flush material off with water. Agents may be used on vertical and overhead surfaces by employing mechanical foam.	Holds contamination in solution. Contamination (unweathered surfaces) reduced 75% in four minutes. Easily stored, carbonates and citrates are nontoxic, noncorrosive.	Requires application from five to 30 minutes. Little penetrating power; of small value on weathered surfaces.
Organic Solvents	Nonporous surfaces (greasy or waxed surfaces, paint or plastic finishes, etc.).	Solution of organic materials (oil, paint, etc.).	Entire unit may be immersed in solvent. Also may be applied by standard wiping procedures (see detergents).	Quick-dissolving action. Recovery of solvent possible by distillation.	Requires good ventilation and fire precautions. Toxic to personnel. Material bulky.

Summary of Surface Decontamination					
Method	**Surfaces**	**Action**	**Technique**	**Advantages**	**Disadvantages**
Inorganic Acids	Metal surfaces, especially those with porous deposits (i.e. rust or calcareous growth). Circulatory pipe systems.	Strong dissolving power on metals and porous deposits.	Dip-bath technique is advisable for movable items. Acid should be kept at a concentration of from 1 to 2 normal.		
Acid Mixtures Hydrochloric Sulphuric Acetic Acid Citric Acid Acetates Citrates	Nonporous surfaces (especially those having porous deposits). Circulatory pipe systems.	Dissolving action.	Applied in same manner as inorganic acids. Mixture consists of: 0.1 hydrochloric, 0.2 lb. sodium acetate, and 1.0 gal. of water.	Dissolving action may reduce contamination 90% in one hour (unweathered surfaces).	Weathered surfaces may require prolonged treatment.
Caustics Lye (sodium hydroxide) Calcium Hydroxide Potassium Hydroxide	Painted surfaces (horizontal).	Dissolving power softens paint (harsh method).	Lye paint-removal mixture: 10 gal. water, 4 lb. lye, 6 lb. boiler compound, .75 lb. cornstarch. Allow lye paint-remover solution to remain on surface until paint is softened to the point where it may be washed off with water. Remove remaining paint with long-handled scrapers.	Minimum contact with contaminated surfaces. Easily stored.	Personnel danger (painful burns). Reaction slow: thus, it is not efficient on vertical surfaces or overheads. Should not be used on aluminum or magnesium. Method is difficult on vertical or overhead surfaces.
Tri Sodium Phosphate	Painted surfaces (vertical, overhead).	Dissolving power (mild method).	Hot 10% solution applied by standard wiping technique. (See detergents.) One-minute rub.	Reduces activity to tolerance in one or two applications.	Destructive effects on paint. Not to be used on aluminum or magnesium.

832. Decontaminating food supplies

Radiologically contaminated food

Following a nuclear attack, widespread damage and contamination could exist in the nation's food supply. The problem will consist of thermal and blast damage of food stocks and neutron-induced activity from close-in detonations. Fallout contamination can also affect unprotected food and water hundreds of miles from the point of detonation. Our primary concern is to prevent ingestion of radioactive contamination in food.

Immediately following heavy fallout, educate all personnel to refrain from consuming foods that are in any way suspected of contamination or have not been protected from direct fallout. We monitor foods for contamination before consumption. As stated in unit 2, the potential for devastation from nuclear materials is well recognized. Whether in times of peace or war, you must be knowledgeable of the effects of radiation on food and food animals. You must also quickly recognize the proper decontamination practice to render a food fit for human consumption.

Blast damage

Fresh food

Fresh food products such as potatoes, apples, and onions packaged in wooden crates will be bruised and crushed by blast pressure. As a result of this mechanical damage, decay during subsequent storage will occur more rapidly. So, foods not rendered completely unusable should be used as soon as possible to prevent loss.

Glass and metal containers offer good protection to foods when the atmospheric pressure sharply increases during a nuclear detonation and shock wave as long as the food is not too close to the detonation. Up to several miles from the nuclear detonation, very few seals on glass and metal containers will be broken by the blast pressure. The blast damage to prepackaged foods results mainly from containers falling from the shelves. However, some containers may be pierced by flying sharp objects. Containers made from soft materials (e.g., paper, polyethylene, or cardboard) may suffer severe damage from flying debris. Splintered glass may cause serious contamination to foods stored in soft packages. Punctured containers allow microorganisms to enter and spoil food products. Damage to cans or jars stored in basements may be negligible even when the main structure of the building is demolished. Mechanical crushing and perforation damage can be minimized by basement storage. Maximum blast protection will also be afforded by permanent-type food storage facilities such as commissary cold storage warehouses. In any case, the food storage area should be out of direct line with windows and doors. Foods stored in basements or in reinforced steel and concrete buildings are also protected from thermal effects.

Meats

Meats and live animals located within a short distance from the blast site will probably be completely destroyed by heat and pressure from the blast. However, as you move away from the blast site you will find foods with only secondary damage from the blast. Blast damage in the form of high blast overpressure and high winds may damage meat tissues. These effects increase the rate of deterioration of the meats. Examine the meats carefully for this damage. If damaged meat is found, use it immediately after careful monitoring and trimming. Common sense is your best tool in determining the edibility of this meat. Trimming of the damaged areas may be all that is needed. However, remember meats may be contaminated with radiation-bearing dust. Therefore, meats like all foods must be monitored with appropriate equipment before being prepared.

Secondary effects

Secondary effects of the blast (e.g., disruption of refrigeration) can result in loss in perishable foods such as chilled or frozen meats if alternate sources of power are not available. Despite lack of refrigeration, frozen foods may be held for several days before thawing occurs. Once the foods are thawed, they should be issued to food facilities. Under conditions of sustained power loss, highly perishable foods (e.g., fresh chilled milk or chilled meats) should have issue priority. It is important that you examine perishable foods carefully for spoilage, recommend destruction of inedible foods, and assist in relocating foods to more suitable storage locations.

Food chain transfer

The passage of radiation fission products through the food chains and into our food is an important concern. Additionally, radioactive fallout may contaminate existing food sources. Radiation causes two types of biological hazards for humans:

1. External hazard from the gamma emitting fallout particle.
2. Internal hazard resulting from the contaminated food and water ingested and air inhaled by livestock and man.

For example, animals grazing on contaminated pasture or consuming contaminated feed and water may ingest many different radioactive isotopes found in fallout particles. The two primary fission products of concern are iodine–131 and strontium–90.

Iodine–131

Iodine–131 resulting from a nuclear detonation is an indirect hazard to humans. The hazard is in the fresh milk produced from dairy animals ingesting contaminated pasture or feed. Approximately 5 to 10 percent of the iodine–131 ingested by a dairy animal is secreted into the milk. The iodine–131 has a half-life of eight days for the emitted beta particles and only two hours for the emitted gamma radiation. If the milk were to be consumed during this time period, the iodine–131 would deposit in the thyroid gland. The amount deposited in the thyroid will vary from person-to-person and region-to-region. A population that consumes a large amount of fish or foods with iodized salt will probably have a lower amount of iodine–131 deposited in their thyroids. On the other hand, a society deficient in stable iodine in their diets would probably exhibit a larger deposit of iodine–131. Stable iodine is used as a method to block the thyroid from absorbing the radioactive iodine. In the case of contamination of our fresh milk supplies with radioactive iodine–131, infants are more at risk since they depend more on milk than adults and the gland tissue in the infant is more sensitive to radioactivity. The unborn fetuses are also to be included in this risk group due to the ability of iodine–131 to cross the placental barrier.

Iodine–131 will reach a maximum concentration in the dairy milk in approximately two to four days after a single detonation or deposit of fallout material on pastureland. Radioactive decay and weathering will reduce the amount of iodine–131 in contaminated vegetation to about 50 percent of the original contamination in about five days. This level is still a major health concern because with today's technology, milk is delivered to the consumer usually within four days after milk production. This does not allow enough time for iodine–131 to decay to safe levels. Postattack countermeasures for prevention of iodine in the food chain include:

1. Eliminating milk from diets. On a short-term basis, many people can eliminate milk from the diet with little difficulty. It is more difficult to eliminate milk from the diets of infants and children. Major problems would be encountered if milk were eliminated on a long-term basis, since milk constitutes a major source of calcium and protein in the diet.
2. Removing iodine–131 from milk. Research indicates that ion exchange resins can be used to effectively reduce iodine–131 from milk during critical periods. It will be some time before the technical capability exists to provide treated milk for more than a small number of consumers.
3. Using stored cattle feed. Use of stored cattle feeds is an effective countermeasure when such feed is available and adequate warning is received in time to implement necessary changes in the feeding practice. Unfortunately, sources of stored feeds capable of supporting large numbers of dairy cattle are not always available. Past experience has shown that without advanced warning, cows may consume large amounts of contaminated forage before control

measures can be initiated. Following such an incident, the feeding of uncontaminated feed will limit the duration of significant levels of iodine–131 in the milk.

4. Storing and marketing milk. Store milk to allow radioactive decay. Decay alone reduces iodine–131 by one-half every eight days. If contamination is light, storage of milk for eight days may be adequate. Freeze packaged milk and store for 30 to 60 days if contamination is high. If all milk sources are critical, consider diluting contamination by blending with uncontaminated milk. Do not destroy or dispose of milk contaminated with iodine–131. Processing fresh milk into longer shelf-life items (e.g., butter, cheese, ice creams, and powdered and canned milk) will allow for storage and further reduction of iodine–131 levels.

Strontium–90

Consuming fallout contaminated vegetation and drinking milk from dairy cows that have fed on contaminated feed and grass are the main pathways through which strontium–90 reaches the human body. Strontium is similar to calcium and the body has a natural preference for calcium over strontium. However, if calcium levels in the body are too low, the body will absorb the strontium–90. Minute levels of the strontium–90 present a serious internal hazard. Remember, strontium–90 has been found to replace calcium in the body when ingested. Because of the possible presence of strontium–90, fresh animal byproducts with a high-calcium content (e.g., milk and other dairy products) should not be consumed following a nuclear blast.

Radioactive fallout

Alpha is a potential hazard only when taken into the body by inhalation or ingestion of contaminated food and water. However, since alpha particles have such weak penetrating power, beta and gamma radiation emitted during decay of fission products are the principal concerns from the standpoint of food and water contamination. Fission products can gain entry into the body when we consume food and water contaminated with fallout.

The contamination of food supplies can be prevented by storage in dust-tight facilities. Packaged food items in original packing material will be completely safe for consumption if the package is intact. Unprotected foods may have surface contamination in appreciable amounts. You'll now learn how to decontaminate packaged foods, fruits, vegetables, and meats.

Packaged foods

Food in cans or other types of sealed containers are in no danger from radiological contamination. Any radioactive contamination will affect only the outer surface of the container, and this can be decontaminated by washing and scrubbing. Contaminated containers, in many instances, will contain food that is entirely safe. Care should be taken not to accidentally transfer fallout particles to exposed food surfaces when packaging material is removed. Under no conditions should cans or other sealed containers be opened until they have been monitored and decontaminated if necessary.

Unpackaged foods

Food not protected in sealed containers must be monitored, and if contaminated, either disposed of or decontaminated. Foods such as potatoes and other hard-skinned vegetables and fruits can be decontaminated by peeling, scraping, washing, or scrubbing. Remove outer leaves of the lettuce or cabbage, then wash. Unpackaged food that has been exposed in a contaminated area may not be worth decontaminating. As a general rule, all unpackaged foods that have been exposed to contamination should be destroyed because boiling or cooking the food will not eliminate the radioactivity.

Meats

The major concern with meats not affected by a direct nuclear blast is fallout contamination. All foods should be monitored prior to consumption. If meats are found to be contaminated, the following decontamination steps may be accomplished:

Meat Type	Decontamination Steps
Canned meats	Wash containers thoroughly and remonitor.
Carcass beef	Trim away the contaminated surface (outer 1/4 to 1 inch) and remonitor. Prevent contamination during transfer from storage to dining halls.
Boxed or wrapped meats	Clean off all dust carefully; open and monitor the product. If not contaminated, move product to an uncontaminated area.

Disposition of contaminated foods

Food wastage will be one of the major problems faced in the event of nuclear war due primarily to lack of public education. No food should be abandoned as unfit for use. Some alternatives to throwing all of the food away are:

1. Set aside to allow radioactive decay.
2. Use highly perishable foods first; canned and packaged foods later.
3. If an emergency situation demands, blend food with uncontaminated food to reduce radioactivity.

Biologically contaminated food

The general principles applicable to decontamination and disinfection for biological agent attack are those fundamental to general hygiene. The objective of decontaminating foods contaminated with biological warfare agents is to ensure individuals, materials, food, water, and areas are safe after exposure to biological agents.

Effectiveness of decontamination

Biological decontamination is the process of destroying the biological agents (killing bacteria and viruses, or inactivating toxins) or preventing them from reaching our personnel. A material employed to destroy biological agents must be effective against a wide range of organisms, rapid in action, nonhazardous to personnel applying it, and available in wartime. Many materials have been tested and found to be effective decontaminants, but none are universally applicable. Decontamination and disinfection are measures that may become necessary after an attack with biological agents. However, some people disagree with the need for disinfection procedures after an attack with biological aerosols. This disagreement is mainly due to the low deposition of particles small enough to drift over a long distance and to the rapid natural decay of biological material caused by ultraviolet radiation present even in diffused sunlight. Research shows approximately 99 percent of the organisms pathogenic to man may be killed by the sun.

Food decontamination

It is your responsibility to identify contaminated food items and have them decontaminated and, if possible, to provide food for human consumption. Some foods can be decontaminated by destroying or neutralizing the biological agent. The method of decontamination will be largely dependent upon the biological agent involved. We should provide guidance for decontaminating food suspected of BW contamination.

When biological agents have been used, contamination of all foods not tightly sealed must be suspected. The use of heat is the most practical means of decontaminating food. Thorough cooking will generally reduce contamination to a safe level so that food can be consumed. However, decontaminated food must not be consumed until public health pronounces it safe. The type and kind of food, as well as the amount of contamination, will determine which procedure should be used. Care should be exercised to ensure that the heat completely penetrates the food for the period of time indicated. Food items may be decontaminated by:

1. Cooking items in a pressure cooker or autoclave at 15 pounds pressure at 250°F for 15 minutes.
2. Baking contaminated items such as bread or bakery items for 40 minutes at 400°F or baking meat at 325°F for about two hours.
3. Boiling food items for at least 15 minutes is an expedient method when no other method is available.
4. Washing food items in 100-ppm chlorine solution for 30 minutes, then peeling, paring, or cooking.

Food stored in containers (e.g., refrigerators, cans, and bottles resistant to the passage of biological agents) requires only that you perform proper exterior decontamination and exercise precautions in opening the containers to ensure the contents are not contaminated. Sealed containers made of metal, plastic, glass, or porcelain can be immersed for five minutes in hypochlorite solution containing about 2 percent available chlorine. Adding one part of household bleach, which is 5 percent available chlorine, to one part water gives approximately a 2 to 3 percent concentration of chlorine. As an expedient method, contamination may be reduced to a safe level by soaking the containers for a minimum of 15 minutes in boiling, soapy water, followed by rinsing. Your hands must be free of contamination during opening operations. Food packages that will not stand immersion should be wiped off with 100-ppm hypochlorite solution and the food must be cooked before eating.

The exterior surfaces of stacks of food packed in impermeable packages can be sterilized by vapor disinfectants (e.g., formaldehyde, ethylene oxide (ETO), or methyl bromide). Refrigerated transporting vans can be used as sterilization chambers. Semitrailer vans are satisfactory chambers in which to sterilize packaged food with formaldehyde vapors, but ETO and methyl bromide are too penetrating to be used in the ordinary semitrailer van.

Foods stored in sacks or other permeable containers also can be decontaminated with methyl bromide or ETO. However, because of the limited availability of these materials, you should rely on cooking before consumption.

Foods that can be peeled or pared may be decontaminated by soaking in 100-ppm chlorine solution for 30 minutes. After decontamination, the food is peeled or pared, washed with potable water and, if appropriate, cooked before eating. This method has been applied satisfactorily to apples and potatoes.

Unprotected meats are of special concern to public health, since many meat items are ideal environments for bacterial growth because of their high moisture and protein content and their neutral pH. As stated earlier, cook meats at 325°F for about two hours.

General Methods of Decontamination and Disinfection		
Type	**Situation**	**Process**
Heat	Most practical method for decontaminating food and water following a BW attack.	Most vegetative bacteria, viruses, parasites, and fungi are killed by boiling for a period of 15 minutes.
	Bacterial spores and certain toxins (e.g., staphylococcus enterotoxin).	Boiling for several hours is necessary.
	Biological agents that have not been identified.	Autoclaving would be an alternative to boiling; however, many materials cannot withstand this process.
Liquid disinfectants (solutions of germicidal substances)	The choice in each case depends upon the situation.	Soak in one of these disinfectants—halogen compounds (hypochlorite or iodine preparations), quaternary ammonium compounds, and acids (acetic acid).
Gaseous disinfectants	Materials and nonfoods.	Gassing with ethylene oxide, formaldehyde, or paraformaldehyde.
Filtration	The main use of filtration procedures is the disinfection of drinking water.	Filtration units (e.g., Reverse Osmosis Water Purification Unit) producing potable water are in common military use.

Identification of biological agents

Laboratory identification of the organisms can be made by swab tests. The preparation of cultures, examination, and identification of the organisms usually constitute a difficult process that consumes many hours or days. Trained technical personnel are required to perform this identification. Refer back to volumes 2 and 3 where sampling procedures and laboratory identification procedures are discussed for this information.

Water decontamination

Detecting and analyzing contamination in water are the responsibilities of the bioenvironmental engineering personnel. The BW decontamination of water is not difficult when regular treatment facilities exist; however, more chlorine probably will be needed than during the ordinary processing of water. If no water treatment facilities are available, water can be decontaminated by boiling for 15 minutes or by distillation if equipment is available. A supply of water purification tablets should be available for emergency situations—two iodine tablets per canteen of water, with a 60-minute contact time is one alternative to boiling. Household bleach or hypochlorite supplies available at laundries, bottling plants, dairies, or swimming pools may be used for disinfection if other materials are not available. Medical personnel should approve the method of disinfection and declare the water safe to drink. The Reverse Osmosis Water Purification Unit (ROWPU) is our best means of decontaminating water containing NBC agents. By design, the ROWPU removes biological agents. Special in-line filters for nuclear and chemical warfare agents are available. During deployment planning, ensure personnel operating the ROWPU have necessary filters and are familiar with their use if NBC contamination is a factor.

Chemical warfare agents on food

With the threat of chemical warfare on our minds, we should be concerned with how to decontaminate food supplies if needed. Unprotected food, forage, and grain supplies may be so contaminated that consumption will produce gastrointestinal irritation or systemic poisoning. The nerve and blister agents are the most dangerous. Although there is no publication that includes all procedures for decontaminating food items, there is a great deal of information available on the handling of potentially contaminated food. The effects of chemical warfare agents on food supplies can be reduced by:

1. Segregating all suspected items.
2. Inspecting food for signs of contamination and then decontaminate as necessary.
3. Reinspectiability and distribute foods only when they are safe for consumption.
4. Dispose of all grossly contaminated foods.

Container protection

The first consideration in handling food in a chemically contaminated environment is determining the degree to which the food item has been contaminated. It stands to reason if the container has been damaged from a detonation of a chemical round, the contamination will be severe. We will therefore concern ourselves with items exposed to a heavy vapor. Certain types of packaging afford ample protection from heavy vapor: sealed glass, sealed cans, sealed wooden barrels, sealed fiberboard, and sealed foil.

In addition to glass, cans, and other materials providing some protection against chemical warfare agent vapors, items inside sealed, undamaged refrigerators, freezers, or vans would also be moderately protected. Additionally, other food supplies in storage are not likely to be seriously contaminated if reasonable precautions are taken to protect them against chemical attack. For this reason, large supplies of food should not be condemned “en masse” simply because they have been exposed to the possibility of chemical contamination. A prompt and careful survey of the supplies may reveal only a few items have been so seriously contaminated that they require special treatment. Prompt segregation of heavily contaminated items will minimize contamination of the rest of the lot. Generally, foods not specially packed in protective packages constitute the major difficulty. The type and extent of contamination, the availability of replacement supplies, and the available means of decontamination will determine if reclamation of the contaminated items is worthwhile.

Container exterior decontamination

In order to use sealed, undamaged packages of food, it is still necessary to decontaminate the exterior of the container prior to opening. The following table outlines how to decontaminate containers. For a quick reference of the chemicals identified in the table, see Appendix C, Chemical Agent Quick Reference Listing.

Agent	Decontamination
CG, AC, SA, DP, CK, GA, PS, CX, GB	Wipe or rinse with either a 2 percent solution of sodium bicarbonate or a 5 percent solution of chlorine. You can make a 2 percent solution by putting one pound of baking soda in 5 gallons of water.
HD, PD, HT, VX, HN, ED, HL, L, MD, GD	Boil for 30 minutes, or by soaking for two hours in either a 5 percent sodium bicarbonate solution or a 10 percent solution of chlorine.

Emergency decontamination

You may be required to decontaminate items that have been exposed to a heavy vapor of chemicals in an emergency situation. The following is a list of decontamination procedures that are to be used as a last resort only in an emergency situation:

Fruits and vegetables

Fruits and vegetables must be hosed down with water for five to 10 minutes and then aired for 24 hours. Leafy vegetables exposed to heavy vapor or liquid should be condemned and buried. The following table explains the decontamination of chemically contaminated fresh fruits and vegetables.

Agents	Procedure
CG, CX, DP, PS, AC	24 hours aeration or soak for two hours in a 2 percent sodium bicarbonate or 5 percent chlorine. Peel or pare as desired.
HD, HN, HT, VX, GA, GB	Boiling for 30 minutes in a 2 percent sodium bicarbonate or soak in 5 percent sodium bicarbonate for one hour, rinse twice with clean water.
HL, PD, ED, MD, SA, CK, L	Destroy.

Meat

Trim meats to a depth of 1 inch, being careful to clean the knife after each individual cut. Wash or soak the meat in a 2 percent sodium bicarbonate solution for 30 minutes, rinse with clean water. Be sure to discard the solution prior to cooking and serving. Decontamination procedures for chemically contaminated meat are explained in the following table.

Agents	Procedure
CG, DP, PS, AC, GA, GB	Wash with a 2 percent sodium bicarbonate solution and air dry.
HD, HN, HT, HL, GD, VX, CK, SA, PD, MD, ED, L	Destroy.

Bagged and bulk foods

The following table explains the decontaminating procedures for bagged and bulk foods:

Food Type	Procedure
Flour	Flour stored in sacks can be placed in air for three or four days and then reinspected. If it is still contaminated, empty it from the sacks and air out for three to four more days.
Sugar	If sugar is slightly contaminated, aeration will decontaminate it. If heavily contaminated, discard.
Granular food in bags	For a slight contamination of granular foods, empty bags and air for three to four days. Then reinspect. For a heavy contamination, granular foods must be condemned and buried.
Bulk grain	Remove 4 to 6 inches of the outer surface of the grain bulk and destroy the grain you remove. Allow remaining grain to air for three to four days.

Remember, this is a guide to emergency decontamination of food. This assumes you do not have a means of resupply and survival depends on utilizing existing food supplies. Again, before you begin to decontaminate any food, consider these basic things:

1. The chemical.
2. The nature of contamination (vapor/liquid).
3. The nature of the food.
4. A practical method for decontamination.

If you do not have all four you can either throw it all out, or play the old game, "You bet your life."

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

829. Eliminating contaminants

1. What are four types of decontaminants?

2. What is the preferred decontaminant for mass patient decontamination?

3. What percent chlorine solution is used to decontaminate:

   (a) Skin:

   (b) Equipment:

4. What are the three other decontamination methods besides washing a patient?

5. What type of air filter must be used when using the vacuuming decontaminating method?

830. Patient decontamination

1. What is the purpose of patient decontamination?

2. How many team members are deployed with one decon equipment package?

3. How many casualties will one decon equipment package decontaminate?

4. Why is it important to maximize ventilation in the decontamination facility?

5. How should patient decontamination facilities be designed?

6. What is M9 detection paper used for in the decontamination facility?

7. What is the preferred filler ingredient in the shuffle pit?

8. How does the decontamination team determine whether or not decontaminating a patient is necessary?

9. What triage category order are patients processed through the decontamination facility?

10. Briefly describe what occurs at each decontamination station within the patient decontamination facility.

11. What process in the decontamination line removes over 90 percent of the contaminant?

12. Before terminating a decontamination station, what must each member ensure?

13. How do you use medical intelligence to manage runoff control?

14. When would be the only time you might remove the BDO during patient decontamination?

831. Decontaminating equipment

1. When should you continue to clean contaminated equipment?

2. Why is abrasion decontamination not recommended for porous surfaces?

3. What equipment decon method is preferred for dry surfaces?

832. Decontaminating food supplies

1. What are the effects of a nuclear blast on meats and live animals? How are they decontaminated?

2. How do we determine the edibility of exposed meat carcasses? How do we make contaminated carcasses edible?

3. Why are we concerned about strontium–90 contamination of fresh milk?

4. How would foods in cans or other sealed containers be affected in a nuclear attack and how should the food be handled?

5. How can potatoes and other hard-skinned vegetables and fruits be decontaminated?

6. What effect does ultraviolet radiation from sunlight have on biological warfare agents?

7. When can biologically decontaminated food be considered safe to consume?

8. What length of boiling time will kill most bacteria, viruses, and parasites?

9. What is the most expedient method of decontaminating contaminated foods when no other method is available?

10. How safe should food stored in refrigerators, cans, and bottles be considered after a biological warfare attack?

11. Why is unprotected meat a special concern after a biological warfare attack?

12. To be safe to drink, how long should water containing spores and toxins be boiled?

13. What are three general methods of decontamination and disinfection other than heat?

14. How should water be decontaminated if it cannot be boiled?

15. In a true emergency situation for using food contaminated with chemical, what decontamination procedures should be followed for supplying food to personnel?

16. How would fresh fruits contaminated with CG or DP be decontaminated?

17. Describe the "last resort" decontamination procedures for meat contaminated with a chemical warfare vapor agent.

18. How should bulk grain be decontaminated if exposed to nerve agent vapor?

19. What are some basic things you must consider any time you resort to using last "resort measures" to decontaminate food?

3–5. Peacetime Nuclear Weapons Accidents

Possession of nuclear weapons bestows upon an organization responsibilities for safeguarding weapons' handlers, weapons' loaders, aircrews, and other auxiliary personnel. In fact, any military or civilian population must be protected from the potential health hazards developed by fabrication, storage, transportation, or physical possession of such services. The weapons we speak of are designed to be safe; but they are handled by humans.

833. Peacetime responsibilities

Historically, the public reaction to weapons accidents has been one of panic. There are a lot of concerns about radiation and its effects on people and food. Our primary reference in the event of an accident is DOD 5100.52–M, *Nuclear Weapon Accident Response Procedures (NARP)*.

Nuclear weapons accidents

The NARP divides nuclear weapons accidents into three different categories based on their degree of severity and potential hazards:

1. Broken Arrow.
2. Bent Spear.
3. Dull Sword.

Broken Arrow

The term *Broken Arrow* is applied to an unexpected peacetime or noncombatant nuclear weapons accident. This incident includes the loss or serious damage to a nuclear weapon or aircraft electronic communication (AEC) component, whether by intentional jettisoning, inadvertent release, or by nuclear or nonnuclear detonation of the weapon, causing radioactive contamination or other public health hazards.

Bent Spear

The term *Bent Spear* means damage, malfunction, or failure of a nuclear weapon has occurred which is sufficient to render it unsafe or nonoperational. The extent of the damage requires major rework or complete replacement of the weapon to assure operational reliability and nuclear safety.

Dull Sword

A *Dull Sword* is any mishap contributing to a nuclear accident or incident that could cause damage to a weapon which USAF field units are authorized to correct (e.g., bent fins or dents in ballistic cases). Any deliberate, unauthorized act that degrades weapon reliability or safety would also be referred to as a nuclear safety deficiency or a Dull Sword. Following are examples:

- Damage or malfunction of the suspension and release systems.
- Failure to adhere to established safety procedures.
- Malfunction or failure of handling, loading, storage, maintenance, transportation, or test equipment involving a nuclear weapon.

Radiation hazards

Among the radioactive elements most often associated with nuclear weapons accidents (Broken Arrow) are tritium, uranium, and plutonium. If a nuclear detonation did occur, strontium–90, iodine–131, and other fission products should be considered as potential hazards. The effects of strontium–90 and iodine–131 on the food supply were discussed in the previous unit. It must be noted that the mathematical possibility of a nuclear detonation occurring as a result of a Broken Arrow is extremely low.

Tritium

Tritium is a gas that diffuses very rapidly and has the capacity to replace ordinary hydrogen in some materials, causing the materials to become radioactive. In its basic form, tritium does not present a severe radiological hazard. It emits a weak beta particle that is not able to penetrate intact skin and is not readily absorbed by the skin or lungs. However, it can combine with oxygen to form tritiated water vapor. In this form, it is readily absorbed through the skin, and almost 100 percent of the vapor taken into the lungs will be absorbed by the body.

Although tritium has a short-biological half-life, which is the time it takes the body to rid itself of one-half the amount, it is highly active. This means that even small quantities within the body emit hazardous amounts of radiation. Since the tritium enters the body as water, it penetrates cell membranes and causes severe damage to cells.

Uranium

Uranium occurs in various natural formations, such as pitchblende. The greatest hazard of uranium to humans is through ingestion because it contains alpha particle contamination. Therefore, food and water supplies that may have been exposed must be inspected and decontaminated as necessary. Significant amounts of uranium contamination may result from a Broken Arrow. However, uranium as a source of radiation is not as hazardous as plutonium radiation.

Plutonium

Plutonium is the most hazardous radioactive material associated with a Broken Arrow. It is easily split and emits alpha, beta, and gamma radiation. There is alpha, beta, and gamma radiation wherever plutonium is found in any quantity. If plutonium particles are thinly dispersed over a large area because of a high-explosive detonation, alpha particles are the main hazard of concern. When associated with fire or explosion, it is readily burned, pulverized, and carried by smoke and hot air currents to contaminate a large area. Accidental human exposure may occur during firefighting and rescue operations, radiological monitoring, and environmental sampling procedures. The primary hazard from plutonium is usually due to resuspension in the air of the minute radioactive particles. These particles, which are alpha emitters, may then be inhaled into the body.

Plutonium is a bone seeker with a biological half-life of 200 years. This means that once inside the body it is transported to and deposited in the bone cells. At the normal rate of function, it would take the body's physiological processes 200 years to eliminate one-half of the radioactivity.

Nonradiation hazards associated with nuclear weapons accidents

Three elements, while not radioactive, are used for their nuclear properties and may present toxic hazards if involved in a nuclear weapon accident or fire. These elements are beryllium, lead, and lithium.

Beryllium

Beryllium is a metal that resembles magnesium. It is extremely toxic. Inhalation is the most significant mode of entry into the body. Beryllium oxidizes easily, and any fire or explosion involving beryllium is almost certain to release hazardous fumes and smoke. Absorption through the skin is also a significant mode of entry for beryllium. Cuts, scratches, and abrasions contaminated with beryllium become ulcerated and heal very slowly. Since it is not radioactive, detection in the field is impractical. In the vicinity of a fire involving this material, protective clothing and some form of respiratory protection is essential.

Lead

Lead is widely used in shielding. Pure lead and most of its compounds are toxic. The metal may enter the body by inhalation of vapors, mists, or fumes; by ingestion; or by skin absorption. Respiratory protection and anticontamination clothing provide adequate protection against lead hazards caused by lead in a fire.

Lithium

Another nonradioactive hazard involved in a nuclear weapon accident is the element lithium. Combined with hydrogen and oxygen, it forms an extremely caustic compound. The mode of entry into the body is through inhalation and skin absorption. In acute exposures, it can cause intense irritations and ulcerations of the skin and respiratory tract.

Protective measures

There are many methods of protecting yourself against radiation. Many of these methods are the same as those discussed in the lesson on protective equipment for a nuclear environment. However, it is important that you relate these measures to a peacetime incident as well.

Personal protection

Personnel performing operations in contaminated areas should wear protective clothing and respiratory protection. Protective clothing should include coveralls, shoe covers, gloves, and a head cover. Clothing should be buttoned and taped closed at all openings. Unprotected skin should not be visible. Wear a protective mask; MCU–2/P masks are efficient protective masks. Upon leaving the contaminated accident area, everyone should be monitored for contamination. Contaminated clothing should be removed and placed in covered containers and transported to a decontamination area. Upon removal of contaminated clothing and equipment, everyone should again be monitored for contamination. NOTE: If possible, decontamination should be done in the field.

Decontamination of patients and medical personnel

Radiation contamination cannot be destroyed, but it can be removed or controlled by decontamination. Decontamination procedures can localize or minimize radiation exposure. Decontamination should be performed according to need. The most important facet of decontamination is the protection of people from exposure to radiation. At the outset, the goal of personnel decontamination is complete removal of contaminants to achieve zero levels of radiation.

The first step in decontaminating our patients and medical personnel is proper removal of contaminated protective clothing. Proper sequence in removal minimizes contamination of skin surfaces and ingestion or inhalation of contaminants. When decontaminating a patient after a peacetime nuclear accident, use the same basic procedures that you learned from the earlier lesson on wartime patient decontamination. There are, however, some differences. For example, brushing and vacuuming with HEPA filters are the decontamination methods of choice. Otherwise, litter and ambulatory patients should be handled like they are handled in patient decontamination.

For decontaminating uninjured personnel leaving the site, use a personnel decontamination station at the contamination control area (CCA). Procedures for personnel decontamination are taught periodically by your disaster preparedness section. A brief synopsis of the procedures for removing the anticontamination (banana) suit include:

1. Leave the gloves on to protect the hands while other items of contaminated outer clothing are removed.
2. First, vacuum/brush top of head and mask.
3. Open Velcro on hood and remove hood.
4. Remove boots.
5. Remove outergarments.
6. Loosen both gloves and put them into the container.
7. Remove socks and underclothing.
8. Shower or sponge bath, using plenty of soap and warm water.
9. Monitor for spot contamination.

If you need to spot decontaminate, follow these steps:

1. Locate, mark, and isolate the contamination to prevent spreading it to other areas.
2. Try to remove the contamination with pieces of masking tape.
3. Monitor between each decontamination attempt to determine the effectiveness.
4. Wash with mild soap and warm water giving special attention to the hairy parts of the body, hands, and fingernails.
5. Rinse, dry, and monitor.

Hand cream can be applied to the area to restore oils to the skin. If contaminants have infiltrated the pores and cannot be removed, sweating may be induced to aid in decontamination. For instance, wearing rubber surgical gloves for about 30 minutes will cause the hands to sweat, washing the contaminants out. The protective mask is removed last!

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

833. Peacetime responsibilities

1. What are the three peacetime nuclear weapons accidents?

2. What is a Broken Arrow?

3. What is a Bent Spear?

4. What are the specific radiation hazards associated with nuclear weapons accidents?

5. What is the most hazardous radioactive material?

6. What are three nonradiation hazards associated with nuclear weapons accidents? What is the mode of entry into the body for each of them?

Answers to Self-Test Questions

818

1. To return combatants back to duty as soon as possible and to ensure that the more seriously injured receive treatment and convalescence.
2. Unit type codes (e.g., deployable teams are the smaller elements that make up the larger medical echelons).

819

1. To train our personnel on their duties in real life situations, and we must hold exercises to practice our skills and test our knowledge.
2. Long-term effects on people and the food chain.
3. Botulinum toxin, anthrax, and aflatoxin.
4. B.C. during the Peloponnesian War.
5. An explosion at a nuclear power plant at Chernobyl caused large amounts of radioactive material to be released into the atmosphere.
6. Chemical agents, specifically mustard and nerve.

820

1. Blast wave.
2. Blast wave and blast wind.
3. Fires from the explosion and fires caused indirectly by the blast.

4. Whole-body irradiation from fallout on the ground, beta particles on the skin, and internal damage from ingested or inhaled alpha and beta particles.
5. Alpha and beta particles.
6. The air burst causes the least radiological hazard because most of the radioactive contamination is spread throughout the atmosphere, with less reaching the ground.
7. The radioactive particles from the burst attach themselves to larger dust or rain falling to the ground where it may enter the food chain.
8. Surface burst.
9. Surface.

821

1. Only personnel are affected, so the enemy can move in and take over the facilities intact.
2. From mortar and artillery shells, bombs, airplane spray, missiles, or by various methods of sabotage. Additionally, vectors may carry the infective organism.
3. Incubation period, difficult identification, unlike other warfare agents, and little chance of causing an epidemic.
4. The ability of the agent to overcome the resistance of the host.

822

1. Pulmonary agents.
2. Stop tissue respiration.
3. Hot weather.
4. Mustards, lewisite, and phosgene oxime.
5. Pinpoint pupils.
6. Temporary visual, mental, and physical disabilities; temporary mental aberrations; and physical aberrations.

823

1. Radioactivity detection, identification, and computation.
2. Roentgen equivalent in man.
3. Radioactivity.
4. Total dose and dose rate.
5. Pocket dosimeter and thermoluminescence dosimeter (TLD).
6. Gamma, beta, alpha and X-ray.

824

1. Aircraft dropping or spraying an unidentifiable material, unusual shells or bombs, smoke or mists of unknown origin, unusual substances on the ground or vegetation, unusual numbers of sick or dead animals, epidemics and nonindigenous diseases, mass casualties, and increase in respiratory diseases.
2. Prompt reporting of sickness and maintaining adequate sanitation, immunizations, quarantine, and treatment practices.
3. When some means of warning occurs to indicate if a sampling is warranted.
4. The ideal location from which to sample a cloud of BW agent is: directly downwind from the point of release, in the open so that trees, buildings, hills, or similar obstacles will not interrupt the path of the cloud; in the case of sprays from aircraft, far enough away from the point of release for the spray to have settled to ground level; in the case of munitions, the best samples would be at or near the point of release. The concentration of agent should be highest at that point. Fragments from the munitions, leaves of vegetation, stones, and other debris near the point of release provide excellent samples and should be forwarded to the laboratory.

825

1. You may be exposing yourself to potentially lethal levels of agents.
2. M8A1 and M90 chemical agent alarms, M256A1 chemical agent detector kit, chemical agent monitor (CAM), M272 water test kit, M8 paper, and M9 tape.
3. It detects nerve agents, vesicants, and cyanigens, and provides agent concentration level information at low, medium, and high. It interfaces with local field radio communications and computer networks.
4. 16 minutes.
5. Nerve, cyanigens, vesicants, and lewisite.
6. When assisting BES, and when checking for water contamination in patient decontamination area.
7. Petroleum products and insect repellents.
8. (1) Someone yells, "GAS, GAS, GAS"; (2) You see someone holding up his or her arms and moving arms inward/outward at the elbows; (3) You hear condition yellow or see a yellow flag (attack is probable); (4) You hear condition red or see a red flag (attack is imminent or in progress); (5) You hear condition black or see a black flag (NBC maybe present); (6) You hear metal banging against metal; (7) You note slow low flying aircraft, especially if there is a mist behind the plane; (8) You see dead animals/birds/insects/people; (9) You see fog; (10) You note tiny dots of liquid on surfaces (plants, vehicles, or anything else); (11) You hear or see munitions exploding; (12) You hear an M8A1 or M90 chemical agent alarm; (13) You see other personnel wearing protective masks.
9. Nuclear (ATOM), biological (BIO), and chemical (CHEM).

826

1. Taping the joints between the sleeves and gloves and the pants and boots.
2. MCU2P protective mask.
3. Distance and shielding.

827

1. Natural resistance of your body.
2. Through cuts, wounds, ingestion, or inhalation.
3. Report illness promptly; keep yourself and your living area clean; take all prescribed medications and immunizations; cover mouth, nose, and skin; protect food and water; keep alert for biological warfare attacks; and protect yourself from aerosols.

828

1. Learn to recognize clues, try to get upwind, and use your protective mask and clothing.
2. The ground crew ensemble (GCE).
3. Stop breathing and close your eyes.
4. Rip off the portion that has been wetted.
5. Ten degrees.
6. When directed to do so by your commander.
7. On the front shirt pocket of the outer garment.
8. When a patient has received three Mark I's and symptoms are still present.
9. Ten to 15 minutes.

829

1. Chlorine solution, soapy water, sodium bicarbonate, and diatomaceous earth.
2. Chlorine solution.
3. (a) .5 percent.

   (b) 5 percent.

4. Brushing, weathering, and vacuuming.
5. High efficiency particulate air filter (HEPA).

830

1. (1) Remove contaminants without further contaminating patient, (2) Remove contaminants without spreading contaminants to decontamination team members, (3) Prevent contamination of medical facility, (4) Control contaminated runoff.
2. 38, consists of two 19-person decontamination teams.
3. 500 casualties.
4. Minimize vapor buildup that would harm patients.
5. Cleaner from entrance to exit.
6. To detect liquid agent contamination and to ensure the integrity of the hot line.
7. Diatomaceous earth.
8. Using M8 paper, M9 tape, CAM, or ADM 300.
9. Immediate, minimal, delayed, and expectant.
10. Triage, perform life saving medical treatment.
    (a) Station 1 (Clothing removal): Removal of clothing, equipment, and bandages.
    (b) Station 2 (Wash): Patient is washed to remove contaminants.
    (c) Station 3 (Remonitoring): Patient is remonitored to ensure contamination has been removed.
11. Station 1, clothing removal.
12. Completely decontaminate their gloves, aprons, and gloves again; remove aprons and hang them up; decontaminate overboot tops then gloves; monitor the entire ensemble for contamination and remove contaminated items; decontaminate boot soles in shuffle pit; and don't remove the mask until after crossing vapor hazard hot line.
13. Determine type of soil prior to deployment.
14. At the CHATH.

831

1. When the equipment is necessary for the continued use or safety of medical assets.
2. Contaminant will penetrate surface through moisture.
3. Vacuum cleaning.

832

1. If they are within a short distance from the blast site, they will probably be completely destroyed by the heat and pressure; however, overpressure and high winds may damage meat tissue, increasing the rate of deterioration.
2. Common sense; monitor for radiation and trim the affected areas.
3. It replaces calcium in the body when ingested.
4. Probably very little if the container is still intact; the outside of the container can be decontaminated by washing and scrubbing. Care should be taken not to accidentally transfer contamination to the food surfaces when the packaging material is removed.
5. Peeling, scraping, washing, or scrubbing.
6. Kills about 99 percent of organisms pathogenic to people.
7. When pronounced safe by public health.
8. At least 15 minutes.
9. Boiling.
10. Probably safe if care is used in decontaminating the exterior surface and opening the container to not transfer contaminates to the food inside the container.

11. Meat items are ideal for bacterial growth because of their high moisture and protein content and their neutral pH condition.
12. Several hours.
13. Liquid disinfectants, gaseous disinfectants, and filtration.
14. By distillation if equipment is available or by two iodine tablets per canteen of water with 60 minutes contact time.
15. Segregate all suspected items, inspect the food for signs of contamination and then decontaminate as necessary, reinspect and distribute all foods only when they are safe for consumption, and dispose of all grossly contaminated foods.
16. Aerate for 24 hours or soak for two hours in 2 percent sodium bicarbonate or 5 percent chlorine. Peel or pare as desired.
17. Trim surface to a depth of 1 inch and wash or soak meat in a 2 percent sodium bicarbonate solution for 30 minutes.
18. Remove 4 to 6 inches of the outer surface of the grain bulk and destroy the grain you remove. Allow remaining grain to aerate for 3–4 days.
19. The chemical, the nature of the contamination (vapor/liquid), the nature of the food, and a practical method of decontamination.

833

1. Broken Arrow, Bent Spear, and Dull Sword.
2. An unexpected peacetime or noncombat nuclear weapons accident.
3. A damaged, malfunctioned, or failed nuclear weapon that is unsafe or nonoperational.
4. Tritium, uranium, and plutonium.
5. Plutonium.
7. Beryllium by inhalation; lead by inhalation, ingestion, and skin absorption; and lithium by inhalation and skin absorption.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to ECI (AFIADL) Form 34, Field Scoring Answer Sheet.

Do not return your answer sheet to AFIADL.

32. (818) A deployable team's specific purpose is to
    a. provide medical care.
    b. check the chlorine levels in drinking water.
    c. train personnel on evacuation routes in the event of a nuclear attack.
    d. educate personnel on the kinds of injuries associated with a nuclear attack.

33. (819) We can effectively use the historical information from nuclear, biological, and chemical events to train our personnel on their duties in a real-life situation mocked after an event and to
    a. hold periodic exercises to practice our skills and test our knowledge.
    b. hold periodic exercises to test our knowledge.
    c. create in-service lesson plans for our unit.
    d. improve our knowledge of these events.

34. (819) In Palomores Spain, what method was used to decontaminate the area where the B-52 bomber crashed?
    a. Adding filler's earth.
    b. Removing the contamination.
    c. Washing with water and soap.
    d. Covering over the affected area with cement.

35. (820) Which type of injuries is associated with a nuclear weapon detonation?
    a. Blast only.
    b. Thermal only.
    c. Radiation only.
    d. Blast, thermal, and radiation.

36. (820) Which type of burst from a nuclear weapon detonation produces little or no radiation hazard on the ground?
    a. Air.
    b. Surface.
    c. Subsurface.
    d. Ground zero.

37. (820) Which type of burst from a nuclear weapon detonation produces the greatest radiological hazard on the ground?
    a. Air.
    b. Surface.
    c. Subsurface.
    d. Stratospheric.

38. (821) Which element is *not* a characteristic of the appearance of biological agents?
    a. Powder.
    b. Aerosol.
    c. Metallic flakes.
    d. Liquid droplets.

39. (822) An early symptom of a cyanigen is
   a. coma.
   b. paralysis.
   c. headache.
   d. burned skin.

40. (823) The Roentgen is a measure of ionization in air due to which type of radiation?
   a. Alpha and beta.
   b. Gamma and X-ray.
   c. Beta and gamma.
   d. X-ray and alpha.

41. (823) Which term is *not* an example of a dose rate RADIAC device?
   a. ADM 300.
   b. PAC–1S.
   c. AN/PDR–27.
   d. Pocket dosimeter.

42. (824) Which statement concerning detection and identification of biological warfare agents is *incorrect*?
   a. Detection and identification may be several days.
   b. You cannot see, feel, or taste germs spread in a BW attack.
   c. Detection and identification must be accomplished by trained personnel.
   d. Diagnosis may be made by placing the contaminated material under a microscope.

43. (824) All the clues will alert you of a biological attack *except*
   a. smoke or mist or unknown origin.
   b. unusual numbers of sick or dead animals.
   c. unusual substances on the ground or vegetation.
   d. indigenous diseases in your area of operations.

44. (825) The M90 chemical agent alarm is connected to a remote alarm center and horn by a 2,000-meter cord for detection of
   a. nerve agents and cyanigens.
   b. cyanigens and pulmonary agents.
   c. vesicants and incapacitating agents.
   d. pulmonary and incapacitating agents.

45. (825) The M272 water test kit is used to test water for nerve agents, vesicants, lewisite agents and
   a. chlorine.
   b. cyanigens.
   c. insecticides.
   d. phosgene oxime.

46. (826) What is the *most* important piece of personal protective equipment when exposed to radiation?
   a. Protective mask.
   b. Protective gloves and inserts.
   c. Impermeable protective suit.
   d. Radiological protective suit.

47. (826) Which of the following provides you the most protection from gamma radiation?
    a. Protective mask.
    b. Distance and shielding.
    c. Radiation protective suit.
    d. Impermeable protective suit.

48. (827) Which statement is *not* a protective measure that should be followed for survival after a biological attack?
    a. Report illness promptly.
    b. Stop taking immunizations.
    c. Cover mouth, nose, and skin.
    d. Take all prescribed medications.

49. (828) Impregnated clothing provides very limited protection against
    a. gases.
    b. vapors.
    c. liquids.
    d. fine sprays.

50. (828) How many degrees does the body temperature increase while wearing the M–2 apron along with battle dress overgarmet during decontamination procedures?
    a. 10.
    b. 20.
    c. 30.
    d. 40.

51. (828) Atropine injection is used as a first-aid measure against
    a. cyanigens.
    b. nerve agents.
    c. cyanigens and nerve agents.
    d. nerve agents and vesicants.

52. (829) What type of air filter *must* be used when using the vacuum cleaning decontamination method?
    a. Normal filter.
    b. MCU–2P mask cartridge filter.
    c. HEPA.
    d. LEPA.

53. (829) When preparing a decontaminating solution out of household bleach, what two solution strengths are used for decontaminating equipment and for decontaminating skin?
    a. 2 percent , 2 percent.
    b. 2 percent, .02 percent.
    c. 5 percent, .5 percent.
    d. .5 percent, .05 percent.

54. (830) Equipment and supplies needed by MTFs with a requirement for patient decontamination equipment packages are listed in Allowance Standard
    a. AS 405A.
    b. AS 101B.
    c. AS 902A.
    d. AS 977C.

55. (831) What equipment decontamination method is recommended for dry surfaces?
 a. Water.
 b. Abrasion.
 c. Vacuum blasting.
 d. Vacuum cleaning.

56. (832) How should you treat meat affected by blast damage from a nuclear explosion?
 a. Monitor for radiation and trim affected areas.
 b. Monitor for radiation and then wash it.
 c. Trim affected areas and cook it.
 d. Destroy it.

57. (832) The movement of iodine–131 through the food chain *cannot* be prevented by
 a. issuing stored milk.
 b. using stored cattle feeds.
 c. eliminating milk from diet.
 d. blending stored milk with fresh milk.

58. (832) How can potatoes and other hardskinned vegetables and fruits be decontaminated following a nuclear attack?
 a. Soaking in a chlorine solution.
 b. Peeling or scraping.
 c. Boiling.
 d. Baking.

59. (832) All are means of minimizing food waste following a nuclear attack *except*
 a. using food rationing.
 b. setting food aside to allow for radioactive decay.
 c. using canned and packaged foods first and throwing perishable foods away.
 d. if an emergency situation demands, blending contaminated food with uncontaminated material to reduce radioactivity.

60. (832) In most situations, the most practical means of decontaminating food and water following a biological attack is through the use of
 a. heat.
 b. filtration.
 c. liquid disinfectants.
 d. gaseous disinfectants.

61. (832) Food contaminated with bacterial spores and certain toxins should be disinfected by
 a. dipping in a 1-ppm hypochlorite solution.
 b. dipping in boiling water for 2–3 minutes.
 c. washing with an alkaline soap solution.
 d. boiling for several hours.

62. (832) Sealed containers of food should be decontaminated by immersing them in
 a. 0.5 percent hypochlorite solution for two minutes.
 b. 0.5 percent hypochlorite solution for five minutes.
 c. 1 percent hypochlorite solution for five minutes.
 d. 2 percent available hypochlorite solution for five minutes.

63. (832) In an emergency, how should flour that has been stored in sacks be decontaminated from vapor chemical contamination?
    a. Mixed with water and boil for 20 minutes.
    b. Exposed to air for several days.
    c. Placed in a freezer for 24 hours.
    d. Reprocessed.

64. (833) Which element does *not* present a nonradiation hazard if involved in a nuclear weapon accident or fire?
    a. Lead.
    b. Lithium.
    c. Uranium.
    d. Beryllium.

65. (833) What is the *most* hazardous material in a peacetime nuclear weapons environment?
    a. Lithium.
    b. Plutonium.
    c. Tritium.
    d. Uranium.

Student Notes

Glossary

Abbreviations and Acronyms

ACS	anticontamination suit
AEC	aircraft electronic communication
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFMIC	Armed Forces Medical Intelligence Center
AFPMB	Armed Forces Pest Management Board
AOR	area of responsibility
ATH	air transportable hospital
BAT	battery auxiliary training
BDO	battle dress overgarment
BEE	bioenvironmental engineer
BES	bioenvironmental engineering services
BVO	black vinyl overboot
BW	biological warfare
CAM	chemical agent monitor
CANA	convulsant antidote for nerve agent
CCA	contamination control area
CDC	Centers for Disease Control
CFU	coliform forming unit
CHATH	chemically hardened air transportable hospital
CMRT	continuing medical readiness training
CONOPS	Contingency Public Health Operations Course
Cpm	counts per minute
CPOG	chemical protective overgarment
CW	chemical warfare
DEAR	disease environmental alert reports
DISRAPS	disease risk assessment profile
DNBI	disease and nonbattle injuries
DOD	Department of Defense

DOWW	disease occurrence worldwide
DPD	N,N-Diethyl-P-Phenylenediamine Sulfate
DPMIAC	Defense Pest Management Information Analysis Center
DVEP	disease vector ecology profile
ECP	entry control point
EMP	electromagnetic pulse
EPA	Environmental Protection Agency
FAC	free available chlorine
GCE	ground crew ensemble
HEPA	high efficiency particulate air filter
IAMAT	International Association for Medical Assistance to Travelers
IAW	in accordance with
IDA	individual dynamic absorption
IDK	initial deployment kitchen
JOPES	Joint Operation Planning and Execution System
JSLIST	joint service lightweight integrated suit technology
KT	kiloton
LHA	liquid hazard area
MCRP	medical contingency response plan
Mgl	milligrams per liter
MI	medical intelligence
MIO	medical intelligence officer
MKT	mess kitchen trailer
MMWR	morbidity, mortality weekly report
MOOTW	military operations other than war
MOPP	mission oriented protective posture
MRE	meal ready-to-eat
MRM	medical readiness manager
MRNCO	medical readiness noncommissioned officer
MRO	medical readiness officer
MTF	medical treatment facility
NAAK	nerve agent antidote
NAPP	nerve agent pyridostigmine pretreatment
NARP	nuclear weapon accident response procedures

NBC	nuclear, biological, chemical
NCOIC	noncommissioned officer in charge
NGO	nongovernmental organizations
NPMIS	Navy Preventive Medicine Information System
NRC	Nuclear Regulatory Commission
OIC	officer in charge
PH	public health
PHT	public health team
PMEL	precision measurement equipment laboratory
PPE	personal protective equipment
ppm	parts per million
PVO	private volunteer organization
R&D	Research and development
RBC	red blood cells
RDIC	resuscitation device individual chemical
ROWPU	Reserve Osmosis Water Purification Unit
RPO	radiation protection officer
TA	table of allowances
TAP	toxicological agent protective
TLD	thermoluminesence dosimeter
TPFDD	Time-Phased Force and Deployment Data
T-rats	tray pack rations
TWDS	tactical water distribution system
URI	upper respiratory illness
UTC	unit type codes
VECTRAPS	Vector Risk Assessment Profile
VHA	vapor hazard area
WBC	white blood cells
WBGT	wet bulb globe temperature
WMP	War and Mobilization Plan

Student Notes

Appendix A. Deployment Preventive Medicine References

FM 21-10 *Field Hygiene and Sanitation*

FM 21-10-1 *Unit Field Sanitation Team Training Manual*

FM 21-76 *Survival*

FM 8-33 *Control of Communicable Diseases Manual* 16th edition, APHA

NAVMED P-5010 *Manual of Naval Preventive Medicine, Preventive Medicine for Ground Forces,* Chaps 1–9

US Navy Medical Department Guide to Malaria Prevention and Control

Medical Environmental Disease Intelligence and Countermeasures (MEDIC CD-ROM) AFMIC

AFI 41-106 *Medical Readiness Planning and Training*

AFI 48-110 *Immunizations and Chemoprophylaxis*

AFJMAN 44-149 *Treatment of Chemical/Agent Casualties and Conventional Military Chemical Injuries*

International Travel and Health, World Health Organization

Health Information for International Travel, Centers for Disease Control and Prevention

Travel and Tropical Medicine Manual, 2d ed., Jong and McMullen, Saunders Publishers

Textbook of Military Medicine, Medical Consequences of Nuclear Warfare, US Army

Manson's Tropical Diseases, 18th ed., Manson-Bahr, Bailiere , Apted, Tindall Publishers

Public Health and Preventive Medicine, 13th ed., Last-Wallace, Appleton-Lange Publishers

Internet sites: CDC, CIA, Stanford Medical School, WHO, and FEMA

Student Notes

Appendix B. Patient Decontamination Equipment Listing

NSN	Nomenclature	Common Name	UI	Unit Price	New	Critical Item	Critical Quantity
1670008204896	PALLET CARGO AIRCRAFT	AIRCRAFT PALLET	EA	$856.96	1	No	
1670009694103	NET CARGO TIE DOWN AIRCRAFT	CARGO NET - TOP	EA	$107.47	1	No	
1670009962780	NET CARGO TIE DOWN NYLON	CARGO NET - SIDE	EA	$90.34	2	No	
3740006414719	SPRAYER INSECTICIDE 8 QT	BUG SPRAYER	EA	$155.14	2	No	
4120004832880	AIR COND 280V 50/60HZ AC	E.C.U. OR ENVIRONMENTAL CONTROL UNIT	EA	$3,422.00	2	No	
4230011013984	DECONTAMINATING KIT	M258A1 PERSONAL DECON KIT	KT	$4.84	100	No	
4230012761905	DECONTAMINATING KIT, SKIN	M291 KIT, REPLACEMENT FOR M258A1	KT	$169.00	40	Yes	20
4230013578456	DECONTAMINATION KIT, INDI	M295 LARGE DECON KIT	KT	$587.00	80	No	
4240011753443	MASK CHEM BIOL SMALL	MCU–2P SMALL MASK	EA	$174.00	7	Yes	7
4240011753444	MASK CHEM BIOLOGICAL MED	MCU–2P MEDIUM MASK	EA	$174.00	14	Yes	14
4240011753445	MASK CHEM BIOLOGICAL LGE	MCU–2P LARGE MASK	EA	$174.00	4	Yes	4
4240011899423	HOOD CHEMICAL BIOLOG MASK	HOOD FOR MCU–2P MASK	EA	$11.62	160	Yes	160
4240012580061	CHEMICAL-BIOLOGICAL MASK:	SMALL M40 MASK, REPLACES MCU–2P	EA	$142.00	7	No	
4240012580062	CHEMICAL-BIOLOGICAL MASK:	MEDIUM M40 MASK	EA	$142.00	38	No	
4240012580063	CHEMICAL-BIOLOGICAL MASK:	LARGE M40 MASK	EA	$142.00	7	No	
4240012608723	CHEM-BIOLOGICAL HOOD	HOOD FOR M40 MASKS	EA	$15.95	160	No	
4240013611319	CANISTER CHEM BIOLOG MASK	FILTER FOR MCU–2P MASK	EA	$8.43	160	Yes	160
4320008529036	PUMP INFLATING MAN 30 IN	BICYCLE PUMP	EA	$11.10	1	Yes	
4320011980817	PUMP UNIT CENTRIFUGAL	WATER PUMP	EA	$132.33	1	No	
4610002050810	MEASURE, DRY, CHEM, WATER	HTH MEASURING CUP	EA	$56.94	2	Yes	
4720002033920	HOSE RUBR WTR 5/8DIA 50FT	GARDEN HOSE	EA	$15.20	16	No	
4730005951103	NOZZLE GARDEN HOSE	GARDEN HOSE NOZZLE OR SPRAYER	EA	$11.88	4	No	
5110000984326	BLADE KNIFE CRASH STEEL2S	RESCUE KNIFE BLADES (REPLACEMENT)	PG	$5.04	10	Yes	10
5110005246924	KNIFE RESCUE SAFETY	RESCUE KNIVES	EA	$28.00	20	Yes	20
5120002933336	SHOVEL HD SZ 2 9.5X11.5IN	HAND HELD SHOVEL	EA	$8.90	4	No	
5430011706984	TANK FABRIC COLLAPSIBLE	LARGE WATER BLADDER	EA	$1,762.00	2	No	
6110012426691	STAND DISTRIBUTION BOX	POLE FOR POWER BOX	EA	$37.24	2	No	
6110012510402	DISTRIBUTION BOX, 120V	POWER BOXES, SWITCHES FOR LIGHTS ETC..	EA	$2,051.81	2	No	
6110012518157	CONVENIENCE OUTLET ASSY	POWER OUTLET BOX	EA	$101.35	3	No	
6135008357211	BATTERY NONRECHARGE1.5V24	D CELL BATTERIES	PG	$8.21	200	No	

NSN	Nomenclature	Common Name	UI	Unit Price	New	Critical Item	Critical Quantity
6150012205588	CABLE ASSY, POWER, ELEC	MAIN POWER CABLE	EA	$1,013.96	3	Yes	3
6230002648261	FLASHLIGHT RT ANGLE 3DC V	FLASHLIGHT	EA	$4.44	40	No	
6230012422016	LIGHT SET GENERAL ILLUM	FLOURESCENT LIGHT KIT FOR TENTS	SE	$877.91	5	No	
6505009947224	POVIDONE-IODINE CLEAN1GAL	IOIDINE DECON SOLUTION	BT	$13.40	6	No	
6510007822698	SPONGE SURG GAUZE4X4IN200	FOUR BY FOURS	PG	$5.53	24	No	
6510007822699	SPONGE SURG 12PLY4X8IN200	GAUZE SPONGE	PG	$14.18	24	Yes	24
6515003245500	DEPRESSOR TONGUE 6IN 100S	TONGUE DEPRESSORS	PG	$0.98	5	No	
6515009357138	SCISSORS BAND CRS 7.25 IN	BANDAGE SCISSORS	EA	$3.83	80	Yes	40
6515013386602	RESUSCITATOR, HAND OPERATED	RDIC, RESUSCITATION DEVICE, IND CHEMICAL	EA	$367.33	2	Yes	2
6530012207186	CARRIER LITTER WHEELED	NATO WHEELED LITTER CARRIER	EA	$448.01	14	Yes	7
6530013807309	LITTER FOLDING RIGID POLE	NYLON MESH LITTER	EA	$94.00	12	Yes	7
6665000508529	PAPER CHEM AGENT DETECTOR	M–8 PAPER	BK	$0.84	50	Yes	50
6665011334964	DETECTOR KIT CHEMICAL	M256- VAPOR DETECTION KIT	KT	$43.06	10	Yes	10
6665011994153	MONITOR CHEMICAL AGENT	CAMS OR CHEMICAL AGENT MONITORING	EA	$6,333.00	6	Yes	6
6665012265589	PAPER CHEMICAL AGENT 2S	M–9 TAPE	RO	$4.59	20	Yes	20
6665013204712	ADM–300A (KIT C)	ADM 300 RADIAC SET, REPLACES ALL OTHERS	EA	$5,200.00	3	Yes	3
6665800993001	ADM 300A- (KIT E)	ADM 300 RADIAC SET, VERFICATION KIT	EA	$750.00	1	Yes	1
6810002424770	CALC HYPOCHL TECH 3.75LBS	HTH	BX	$88.39	5	No	
7105002698463	CHAIR FOLDING STEEL	FOLDING CHAIR	EA	$12.36	12	Yes	12
7125005901768	SHELVING STORAGE FOOD	METAL SHELVING	EA	$556.80	2	No	
7240008197735	WASTE RECEPTACLE 32 GAL	LARGE PLASTIC TRASH CAN W/LID	EA	$15.53	15	Yes	12
7240013580807	PAIL UTILITY STEEL 28 QTS	STEEL BUCKET	EA	$6.24	20	Yes	16
7290002248308	DUSTPAN STEEL 7IN LG	DUSTPAN FOR SWEEPING	EA	$1.30	2	No	
7290010609260	HANGER COAT PLASTIC	COAT HANGER FOR APRONS OR CHEM SUITS	EA	$1.03	40	No	
7510000744961	TAPE, PRES SENS ADHESIVE	GREEN DUCT TAPE	RO	$5.98	20	Yes	20
7920002406358	BRUSH DUSTING, BENCH 13IN	DUSTING BRUSH	EA	$3.71	6	No	
7920002924370	BROOM UPRIGHT FIBER	BROOM FOR SWEEPING	EA	$7.68	2	No	
8105008377757	BAG,PLASTIC	SMALL PLASTIC BAGS	BX	$27.53	1	No	
8105012213239	BAG PLASTIC 60 X 36 200S	LARGE PLASTIC BAGS	BX	$21.85	1	Yes	1
8145012889932	SHIP&STORAGE CO85.5X105IN	BROOKS-PERKINS CONTAINERS	EA	$7,223.60	2	Yes	2
8340002619751	PIN TENT WOOD 24IN LG	WOOD TENT PEG	EA	$1.00	60	No	
8340008237451	PIN TENT 0.625 X 12 IN	METAL TENT PEG	EA	$1.70	60	No	
8340011863024	FLOOR TENT SINGLE PLY	SUB FLOORING	EA	$227.50	4	No	
8340011863030	CONTAINER, TENT PIN	TENT PIIN BOX	EA	$8.10	3	Yes	3

NSN	Nomenclature	Common Name	UI	Unit Price	New	Critical Item	Critical Quantity
8340011985358	FLY TENT	RAIN FLY	EA	$294.20	4	No	
8340011987618	END SECTION TENT CLOTH	END SECTION TENTAGE	EA	$394.80	5	No	
8340012116788	DOOR TENT 27.83IN W	BUMP DOORS	EA	$750.90	2	No	
8340012136006	WINDOW TENT DUCK TAN	WINDOW SECTION TENTAGE	EA	$499.75	8	No	
8340012388101	FRAME SECTION TENT	TENT FRAMES	EA	$395.15	10	No	
8415002817814	APRON TOX AGT PROTECT M–2	MEDIUM M2 APRONS	EA	$53.85	20	Yes	20
8415002817815	APRON TOX AGT PROTECT M–2	LARGE M2 APRON	EA	$53.85	20	Yes	20
8415011371704	SUIT CHEMICAL PROTECTIVE	MEDIUM B.D.O.	EA	$97.95	80	Yes	20
8415011371705	SUIT CHEMICAL PROTECTIVE	LARGE B.D.O.	EA	$97.95	80	Yes	80
8415011382496	GLOVE INSERT LARGE	WHITE COTTON GLOVES	PR	$1.00	160	Yes	160
8415011382498	GLOVES CHEMICAL SZ MEDIUM	MEDIUM RUBBER GLOVES	PR	$7.65	160	Yes	160
8430013173379	OVERSHOES CHEMICAL MENS 8	NO LACE RUBBER BOOTS	PR	$17.15	20	Yes	20
8430013173380	OVERSHOES CHEMICAL MENS 9	NO LACE RUBBER BOOTS	PR	$17.15	50	Yes	50
8430013173381	OVERSHOES CHEMICAL MENS10	NO LACE RUBBER BOOTS	PR	$17.15	50	Yes	50
8430013173382	OVERSHOES CHEMICAL MENS11	NO LACE RUBBER BOOTS	PR	$17.15	30	Yes	30
8430013173383	OVERSHOES CHEMICAL MENS12	NO LACE RUBBER BOOTS	PR	$17.15	10	Yes	10
8460002433234	TRUNK, LOCKER BARRACKS		EA	$56.65	2	Yes	2
9390002905089	DIATOMACEOUS EARTH 50LB	DRY DECON SOLUTION	BG	$14.36	3	No	
9905013464716	SIGN KIT, CONTAMINANT	NBC MARKING KIT	EA	$133.00	2	No	

Student Notes

Appendix C. Chemical Agent Quick Reference Listing

Type of Agent	Symbol	Onset	Odor	Effects	First Aid/Treatment	Decon
Vesicants						
Sulfur mustard	H HD	Hours	Garlic or horseradish, irritating.	Erythema, blisters. Irritation of eyes.	Eyes: antibiotics, muscle relaxer (cycloplegics) and systemic Pain relief (analgesia).	For liquid contamination of eyes, initially irrigate with copious amounts of water; then at the MTF, with sodium bicarbonate or saline eyewash. Remove contaminated clothing.
Nitrogen mustard	HN		None or fishy, irritating.		Skin: local dressings and antibiotics for infection. Antibiotics for respiratory infection. IV fluids.	For skin use M291 packet. For individual equipment use M295 packet.
Lewisite	L	Immediate	Fruity to geranium-like, very irritating.	Immediate pain. Erythema, blisters. Irritation of eyes.	Like sulfur and nitrogen mustards. BAL in oil IM for systemic chelation, BAL ointment for eyes and skin.	Like HD and HN.
Phosgene oxime	CX	Immediate	Unpleasant and irritating.	Immediate burning & irritation followed by wheal-like skin lesions and eye and airway damage.	Wash with large amounts or isotonic sodium bicarbonate.	Apply dressings pf sodium bicarbonate. Systemic analgesics. Treat as any other necrotic skin lesion.

Type of Agent	Symbol	Onset	Odor	Effects	First Aid/Treatment	Decon
Cyanigens						
Cyanogen chloride	CK	Seconds	Very irritating.	Loss of consciousness,	Skin decontamination is usually not necessary because the agents are highly volatile.	Drugs binding cyanide. IV sodium nitrate and sodium thiosulfate.
Hydrogen cyanide	AC	Seconds	Faint, bitter almonds.	convulsions, loss of breath (apnea).	Wet, contaminated clothing should be removed and the underlying skin decontaminated with water or other standard decontaminates.	Assisted ventilation and oxygen.
Pulmonary						
Phosgene	CG	Hours	Green corn, grass, or newly-mown hay.	Eye and airway irritation, labored breathing (dyspnea), chest tightness, and delayed pulmonary edema.	Vapor: fresh air. Liquid: copious water irrigation.	Corticosteriods IV and by inhalation promptly may be lifesaving. Rest, oxygen, and antibiotics.

Type of Agent	Symbol	Onset	Odor	Effects	First Aid/Treatment	Decon
Incapacitating						
	BZ	Several hours	None	Blurred vision, dry nose and throat, headache.	Restraint, cool environment, prompt evacuation.	For contamination of skin wash with soap and water.
d-lysergic acid diethylamide	LSD		None	Poor concentration, hallucinations, and inability to act in a sustained or purposeful manner.	Physostigmine, diazepam.	
Nerve						
G-Agents:						
- *Tabun* - *Sarin* - *Soman* - *GF*	GA GB GD GF	Seconds	None, or faint sweetishness, fruity or paint-like.	Vapor: contraction of the pupil (miosis), free discharge of thin nasal mucus (rhinorrhea), dyspnea. Liquid: sweating, vomiting. Both: convulsions, dyspnea.	Pretreatment with pyridostimine. Post exposure: 1) Cholinergic blockade–atropine. 2) Enzyme reactivation–oximes (2 PAM Cl). 3) Anticonvulsant - diazepam (CANA). 4) Assisted ventilation. 5) Suction for respiratory secretions.	Remove contaminated clothing. For skin use M291 kit. For individual equipment use M295 packet IAW established procedures.
V-Agents: - *VX*	VX	Minutes to hours	None			

Type of Agent	Symbol	Onset	Odor	Effects	First Aid/Treatment	Decon
Tear						
o-chlorobenzylidene molonitrile	CS	Seconds	Very irritating, pungent, pepper-like.	Burning, stinging of eyes, nose, airways, and skin.	Fresh air, spontaneous improvement.	Wash eyes with copious amounts of water.
chloroaceto-phenone	CN					
Vomiting						
diphenylchloroarsine	DA	Delayed for several minutes	Burning fireworks.	Pain, tightness of nose and throat. Salivation, vomiting.	Wear mask in spite of symptoms. Spontaneous improvement.	Wash with copious amounts of water or isotonic sodium bicarbonate.
diphenylcyanoarsine	DC		Very irritating.	Severe headache.		
diphenylamino chloroarsine	DM					

Student Notes

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