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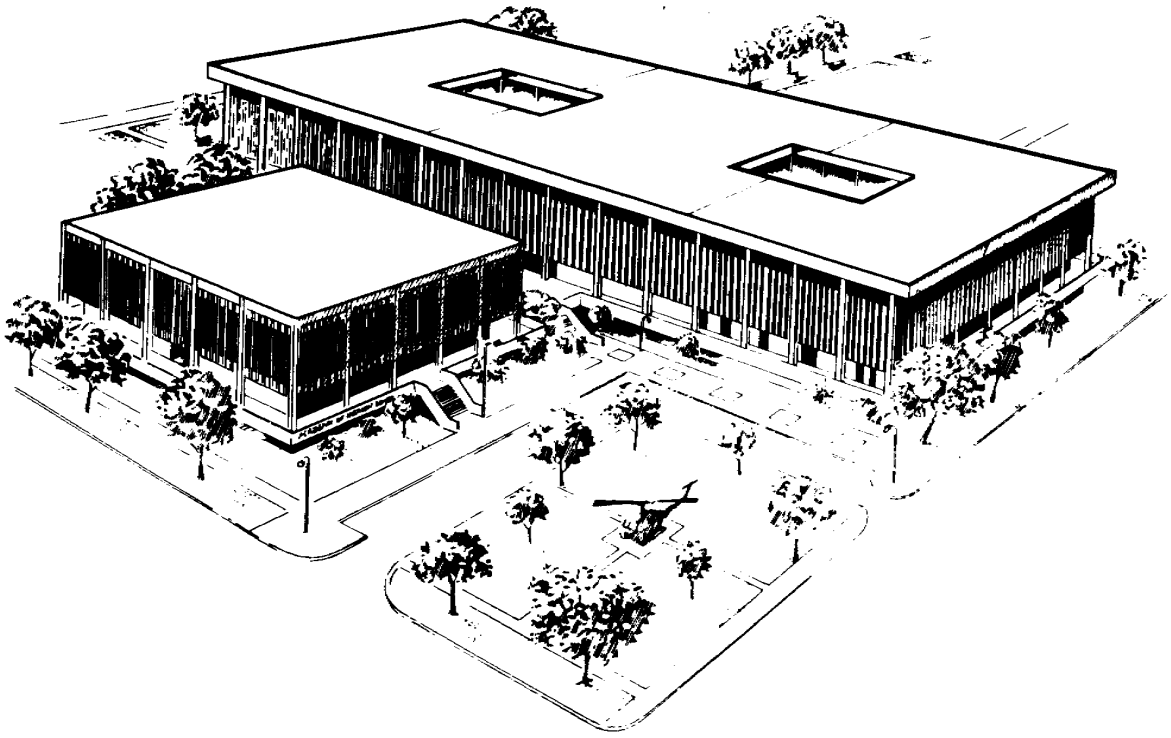

DISEASES OF MILITARY IMPORTANCE

SUBCOURSE MD0152 **EDITION 100**

DEVELOPMENT

This subcourse is approved for resident and correspondence course instruction. It reflects the current thought of the Academy of Health Sciences and conforms to printed Department of the Army doctrine as closely as currently possible. Development and progress render such doctrine continuously subject to change.

When used in this publication, words such as "he," "him," "his," and "men" 'are intended to include both the masculine and feminine genders, unless specifically stated otherwise or when obvious in context.

The instructional systems specialist responsible for development of this edition was William H. Shade, DSN 471-8906 or commercial (210)221-8906; Academy of Health Sciences, Multimedia Development Branch, ATTN: MCCS-HLD, 2250 Stanley Road (Room 326), Fort Sam Houston, Texas 78234-6130.

The subject matter experts responsible for writing and content accuracy of this edition were from Preventive Medicine Division, DSN 471-8909 or commercial (210)221-8909; Commander, U.S. Army Medical Department Center and School, ATTN: MCCS-MP, Fort Sam Houston, Texas 78234-6100.

ADMINISTRATION

Students who desire credit hours for this correspondence subcourse must meet eligibility requirements and must enroll through the Nonresident Instruction Branch of the U.S. Army Medical Department Center and School (AMEDDC&S).

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CORRESPONDENCE COURSE OF
THE U.S. ARMY MEDICAL DEPARTMENT CENTER AND SCHOOL

SUBCOURSE MD0152

DISEASES OF MILITARY IMPORTANCE

INTRODUCTION

Throughout the history of the world, disease has been man's worst enemy. Probably the most dreadful episode in recorded history was the infamous "Black Death" epidemic of the 14th century, which was responsible for the death of one-fourth of the population of Europe. Other epidemics, though not so dramatic as the plague epidemic, have wreaked havoc upon civilizations and primitive populations as well.

When diseases are present in the general population, the hazard is even greater to armies. Because of the large numbers of soldiers who live in close association with one another--sometimes in a hostile environment and with less than desirable facilities--diseases, once started, can run rampant if they are not immediately checked. Until World War I, disease took a far greater toll of manpower than did enemy fire. Napoleon Bonaparte, though considered a military genius, lost over 400,000 of his. 500,000-man army which invaded Russia in 1812 to disease and cold injury, while only 60,000 were killed as a result of direct battle injury. In a previous expedition in Haiti, he had lost 20,000 of a 22,000-man force to the ravages of yellow fever. The U.S. experience has not been without similar tragedies. During the Civil War, more than twice as many men in both the Union and Confederate armies died from disease as from battle wounds. During the Spanish-American War, more than seven men died from disease (primarily yellow fever) to each man who fell in combat.

Improved medical techniques, antibiotics, and research have done much to bring disease, as a military factor, under control; however, hospital admissions due to disease and noncombat injury continue to far outweigh those due to direct battle causes. It is, thus, of the utmost importance that you know and understand the causes and means of prevention of those diseases that are of military importance.

Subcourse Components:

This subcourse consists of 7 lessons, an appendix, and an examination. The lessons are:

Lesson 1, General Concepts

Lesson 2, Food- and Water-Borne Diseases

Lesson 3, Respiratory Diseases

Lesson 4, Injuries Due to Environmental Extremes

Lesson 5, Arthropod-Borne Diseases

Lesson 6, Pest Management in a Field Environment

Lesson 7, Miscellaneous Diseases and Immunizations

Credit Awarded:

Upon successful completion of this subcourse, you will be awarded 20 credit hours.

Materials Furnished:

Materials provided include this booklet, an examination answer sheet, and an envelope. Answer sheets are not provided for individual lessons in this subcourse because you are to grade your own lessons. Exercises and solutions for all lessons are contained in this booklet. *You must furnish a #2 pencil*.

Procedures for Subcourse Completion:

You are encouraged to complete the subcourse lesson by lesson. When you have completed all of the lessons to your satisfaction, fill out the examination answer sheet and mail it to the AMEDDC&S, along with the Student Comment Sheet, in the envelope provided. *Be sure that your social security number is on all correspondence sent to the AMEDDC&S*. You will be notified by return mail of the examination results. Your grade on the examination will be your rating for the subcourse.

Study Suggestions:

Here are some suggestions that may be helpful to you in completing this subcourse:

--Read and study each lesson carefully.

--Complete the subcourse lesson by lesson. After completing each lesson, work the exercises at the end of the lesson, marking your answers in this booklet.

--After completing each set of lesson exercises, compare your answers with those on the solution sheet, which follows the exercises. If you have answered an exercise incorrectly, check the reference cited after the answer on the solution sheet to determine why your response was not the correct one.

--As you successfully complete each lesson, go on to the next. When you have completed all of the lessons, complete the examination. Mark your answers in this booklet; then transfer your responses to the examination answer sheet using a #2 pencil and mail it to the AMEDDC&S for grading.

Student Comment Sheet:

Be sure to provide us with your suggestions and criticisms by filling out the Student Comment Sheet (found at the back of this booklet) and returning it to us with your examination answer sheet. Please review this comment sheet before studying this subcourse. In this way, you will help us to improve the quality of this subcourse.

LESSON ASSIGNMENT

LESSON 1	General Concepts
LESSON ASSIGNMENT	Paragraphs 1-1 through 1-9
LESSON OBJECTIVES	After completing this lesson, you should be able to:
	1-1 Identify typical patterns in the medicine of disease and injury in wartime and peacetime.
	1-2 Identify responsibilities for the health of command.
	1-3 Match terms related to disease transmission with their meanings.
SUGGESTION	After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 1

GENERAL CONCEPTS

Section I. INTRODUCTION

1-1. PURPOSE

The purpose of this subcourse is to discuss the epidemiology, and the control of diseases of actual or potential military importance. The viewpoint is that of the commander and his medical advisors in a war or preparation for war setting.

- The commander has an interest in the health of individuals and groups making initial entry into the Army.
- The commander is interested in the threat to troops from disease endemic orepidemic in areas of the world that is actual or potential battlegrounds or training grounds.
- The commander is interested in non-effectiveness and lost time because of diseases his command is likely to experience under various circumstances.
- The commander's interest is clear-cut, because his responsibility for the health of those under his command is clearly defined.
- Peacetime incidences and experience rates are important considerations, too, in that communicable diseases, which cannot be eliminated or effectively controlled in peacetime generally, are the ones most likely to become epidemic in war.

1-2. DISEASE AND INJURY IN WARTIME

History shows that disease and injury, as military problems are factors for which the military leader must plan. In Table 1-1, the periods of war listed were ones in which combat was the heaviest. In spite of these concentrated fighting periods, hospital admissions for disease and non-battle injury far exceeded admissions because of hostile action of the enemy. Furthermore, experience reveals that hospital admissions for disease usually exceed hospital admissions for non-battle injury and battle injury combined. For example, of the 81.8 percent hospital admissions for disease and non-combat injury in Vietnam in 1969, only 13.7 percent were for nonbattle injury and 68.1percent were for disease.

War Period and Location	Disease and Noncombat Injury (percentage)	Battle Injury (percentage)
Pacific Theater of Operations Nov 1942 to Aug 1945 (WWII)	95	5
European Theater of Operations June 1944 to May 1945 (WWII)	77	23
Korean War July 1950 to July 1953	83	17
Vietnam War 1 Jan 1969 to 31 Dec 1969	81.8	18.2

Table 1-1. US Army hospital admissions during selected war periods

1-3. PREVALENCE OF DISEASE IN PEACETIME

Prevalence of disease in peacetime serves as a baseline against which to estimate probable wartime incidence and attack rates. Acute respiratory infections often account for about one-third of the disease admissions among active duty Army personnel. Normally, the second most frequent cause of admission is nonbattle injury. Diseases of the digestive system account for about 10 percent of admissions.

Often mild cases of illness are not seen by the medical service, and asymptotic infections go unreported. This is known as the “iceberg effect.”

1-4. RESPONSIBILITIES FOR HEALTH

a. **The Commander and Trained Specialists.** The commander of a military organization is responsible for the health of his command. In the fulfillment of this responsibility, he is assisted by a staff of trained specialists. The surgeon, who is the chief medical advisor to the commander, provides technical medical advice and is responsible for the successful functioning of the medical service within the command.

b. **Military Medicine and War**

(1) Military medicine part of the machinery of war. Military medicine is an active part of the machinery of war. Unless military medicine is thoroughly integrated into military plans and operations, unnecessary costs in manpower and in time loss may be the price paid to gain objectives.

(2) Example. This is starkly illustrated by the situation existing in the occupation of Lebanon by United States troops in 1958.

- Preventive medicine units were phased in three weeks late.

- No provision was made for the procurement of unskilled labor to help control arthropod-borne diseases.

- Insecticides accompanying the units were not satisfactory because of the high degree of resistance to DDT insecticide that had developed in the local insect populations.

- Unit commanders neglected enforcement of the most elementary principles of basic sanitation.

- Hospital admissions because of diarrhea and dysentery reached the astronomical level of 3,650 per 1,000 men per year.

(3) Meeting health responsibilities. If health responsibilities are to be met, command must understand military medicine and the implications of disease and injury, and Army Medical Department personnel must be acquainted with military theory and practice. Mutual effort is fundamental if planning and operations are to be successful.

(4) Importance of the military mission. The commander employs the troops to fulfill his mission; however, he requires troops in good health. His plans and decisions are based in part on information he receives concerning the health of the command and on recommendations of AMEDD personnel.

c. **Formulate Preventive Medicine Measures with the Mission in Mind.** The military mission of a command is all-important; all preventive medicine measures for the command must be formulated with this in mind.

- It is more reasonable to prevent disease than to treat it.

- When troops are training for or engaged in combat, however, health measures that interfere with military activity more than the condition, which they are designed to correct, are not feasible.

- Large-scale disease control measures must be practicable, simple, and capable of being performed in a short period.

Section II. COMMUNICABLE DISEASES

1-5. INTRODUCTION

Not all of the diseases discussed in this subcourse are communicable; however, the major emphasis is on communicable diseases.

a. **Communicable Diseases Defined.** Communicable diseases are those illnesses that can be transmitted from human too human or from animal too human. Each of these illnesses is caused by a specific infectious agent or its toxic products.

b. **Etiologic Agents or Pathogens.** Some of the relatively simple forms of life, classified as viruses, rickettsiae, protozoa, bacteria, fungi, or helminths (worms), are etiologic (causative) agents or pathogens. All of the disease agents considered in this publication, with the exception of certain worms and the scabies mite are of microscopic or submicroscopic size.

1-6. SPECTRUM OF INFECTION

a. **Definition.** Infection is the entry and multiplication of any infectious agent in the body. The period between infection and onset of signs and symptoms of disease is called the incubation period.

b. **Carriers.** However, infection does not always result in recognizable disease. Frequently the body has enough resistance or immunity to prevent disease development, in which event a carrier state results.

- A carrier can transmit disease in the same way as can a case (a person who is ill) with the same infection.

- Since the carrier is infected but is not sick, the carrier often goes undiscovered as a source of disease or else is discovered only through very thorough clinical or laboratory procedures.

c. **The Spectrum of Infection.** When an infectious agent strikes a community or military unit, its presence quite likely will be manifested variously in the affected individuals by all grades of severity, from the inapparent carrier state through the mild and typical disease states to the most severe and possibly fatal reactions.

- For example, one individual with a meningocortical infection may suffer no more than a sore throat, while another with the same infection may suffer fever, delirium, and death.

- This broad gradation of manifestations of the infectious process in a group is called the spectrum of infection.

1-7. THE CHAIN OF DISEASE TRANSMISSION

Each case or carrier of a communicable disease potentially represents a step in a series of events, which may lead to the development of a new case.

a. **The Steps in the Chain.** Each step in this series is dependent on the successful completion of the preceding step to form a link in the chain of the spread of disease. The three links in this chain are:

(1) The source, or reservoir, of disease

(2) The means of transmission (the vector or vehicle)

(3) The individual susceptible to the disease (see Figure 1-1)

b. **A Host.** Any person, animal, or arthropod, which harbors a disease agent at any link in the chain, is referred to as a host. An intermediate host is one that acts as a vehicle in transmitting a disease, while a definitive host is a susceptible that provides the site in which the agent produces the infection.

1-8. COMMUNICABLE DISEASE CONTROL

Disease control measures may be viewed as means of breaking the links in the chain of disease transmission (see Figure 1-2). If any one of the links in the chain is broken, disease will not occur.

a. **The Weak Link in the Chain.** The infection chain for each specific disease usually has one link that is more vulnerable or easily broken than the others. While the chain may be attacked at several points on all three links, the major effort usually is made against the weakest link.

b. **Personal Hygiene.** The one disease control measure that is applicable to all three links is personal hygiene.

- Personal hygiene is defined as the application, by the individual, of the principles of healthful living.

- It embraces more than mere personal cleanliness.

- Achieving a high level of personal hygiene requires the individual to practice health rules to safeguard his health and health of others.

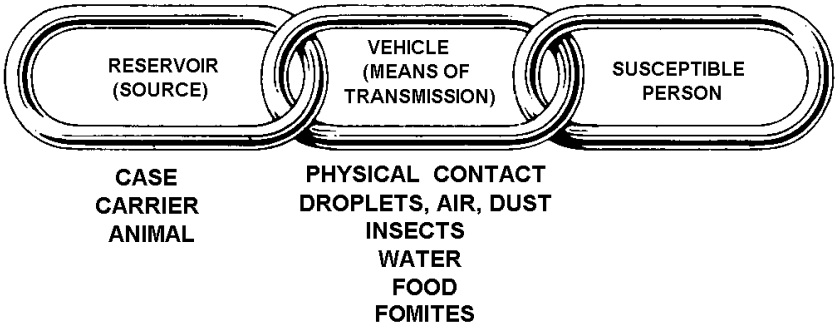


Figure 1-1. Chain of disease transmission.

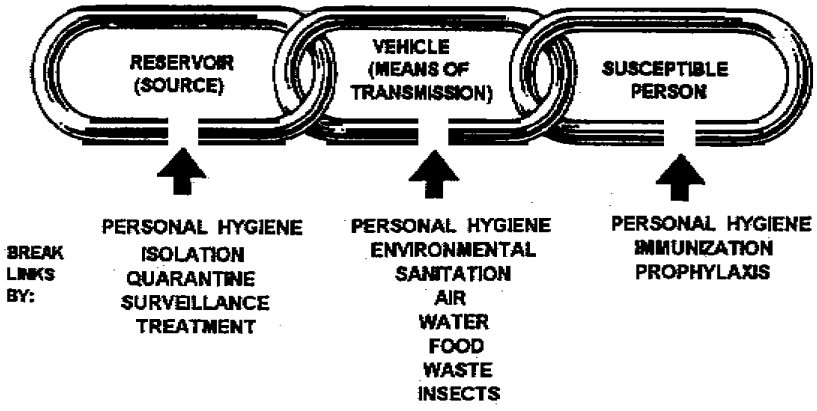


Figure 1-2. Breaking the chain of disease transmission.

c. **Healthful Living.** Every individual is potentially, to a greater or lesser degree, a source of disease, a vehicle of transmission, and a person susceptible to disease. Therefore, universal and unrelenting application of the principles of healthful living does much to prevent the spread of disease.

d. **Control Measures Applicable to the Source**

(1) Isolation. Isolation is the separation of infected persons from others during the period in which the infection is communicable.

- Isolation is practiced in the occurrence of such diseases as pneumonic plague and other highly contagious diseases.

- This separation may be accomplished by having the sick person admitted to hospital isolation or by self-isolation practiced by the infected person.

- In self-isolation, the infected person should separate himself from usceptibles by a distance of more than five feet, practice good personal hygiene, and avoid the spreading of disease agents as much as possible.

(2) Quarantine. Quarantine is the restriction of movement or activities of well persons who may have been exposed to contact with a communicable disease.

- The purpose of Quarantine is to prevent contact between these probable carriers and other people who have not been exposed.

- An example of quarantine is the practice of excluding adult diphtheria contacts from food-handling work until they are proven not to be carriers.

(3) Medical surveillance. Medical surveillance consists in observing and supervising people who, through association with a disease source, have had an opportunity to acquire a disease.

- Surveillance of these contacts permits early recognition of disease without restriction of movement.

- In the presence of a threatened epidemic, examination of all troops may be ordered.

(4) Treatment. Prompt and adequate treatment of disease sources assists in the destruction of the infectious agent.

e. **Control Methods Applicable to the Vehicle**

(1) Agents that can transmit communicable disease. Air, food, water, clothing, bedding, waste, people, and various forms of animal life in the environment have the capacity to transmit communicable disease agents. Environmental sanitation is essential for the control of transmitting agents.

(2) Principles in environmental sanitation. The following principles are included in environmental sanitation:

- Good personal hygiene by each individual
- Avoidance of overcrowding and close physical contact
- Proper ventilation of living quarters
- Water purification
- Careful selection and preparation of food

- Maintenance of food service sanitation
- Sanitary waste disposal
- Proper control of disease-carrying insects and animals

f. **Control Methods Applicable to the Susceptible Person.** A "susceptible" or "nonimmune" is a person who has little resistance against a particular disease organism and who, if exposed to this organism, is likely to contract the disease. Protection of the susceptible requires the use of all measures necessary to maintain or improve general health.

- The individual who has good mental and physical health has good resistance to disease.
- Good personal hygiene, including avoidance of known or suspected sources of disease, helps maintain health.
- Immunizing agents are available for use in conjunction with other measures for the control of some, but not all, communicable disease.
- In some instances, suppressive drugs are available to decrease the severity of disease.
- Some diseases confer immunity against further attacks by the same agent.

-- Normal childhood diseases, such as mumps and measles, are examples.

-- Some closely related diseases, such as smallpox and vaccinia, confer cross immunity. An individual who contracts one of these diseases develops immunity against the other.

1-9. CLASSIFICATION OF COMMUNICABLE DISEASE

Communicable diseases may be classified in more than one way. In this text, diseases are classified into five groups, based on the mode of transmission or entry into the host and the type of major control measures required for their defeat.

a. **Food-Borne and Water-Borne Diseases.** Food- and water-borne (intestinal) diseases are transmitted by any of the various means by which infectious human or animal excrement gains entry into the digestive tract of a susceptible person, primarily through the consumption of contaminated food, water, or food service equipment. This group includes such diseases as typhoid fever, cholera, and various diarrheas.

b. **Respiratory Diseases.** Respiratory diseases are those acquired primarily through inhalation of causative agents. While some respiratory diseases affect the respiratory system, others are manifested principally in other body areas. The common cold, influenza, and smallpox are examples of respiratory diseases.

c. **Arthropod-Borne Diseases.** Arthropod-borne diseases are transmitted by arthropods, including insects such as mosquitoes, lice, fleas, and flies; and by arachnids, including ticks and mites. Most disease-bearing arthropods (disease vectors) are bloodsuckers. Malaria, yellow fever, typhus fever, and plague are classical examples of arthropod-borne diseases.

d. **Miscellaneous Diseases** Miscellaneous diseases include those that do not fit into one of the groups named in (a) through (c) above and also include those for that the transmitting agent is unknown.

CLASSIFICATION OF COMMUNICABLE DISEASES

- ✓ **Food-borne diseases.**
- ✓ **Water-borne diseases.**
- ✓ **Respiratory diseases.**
- ✓ **Arthropod-borne diseases.**
- ✓ **Miscellaneous diseases.**

Figure 1-3. One method of classifying communicable diseases

Continue with Exercises

EXERCISES, LESSON 1

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. The baseline against which to estimate the prevalence of disease in wartime is _____.

2. Two reasons for preventive medicine measures being considered are:

   a. The health of the troops

   b. _____

3. Communicable diseases are _____.

4. The meaning of the term “incubation period” in relation to a communicable disease is _____.

5. List two ways to determine whether a healthy appearing individual is a carrier of a communicable disease.

   a. _____

   b. _____

6. The words “spectrum of infection” mean _____.

7. List the three links in the chain of disease transmission.

   a. _____

   b. _____

   c. _____

8. List 4 control measures that may be applied to the human who is the source in the chain of transmission of a communicable disease.

   a. _____

   b. _____

   c. _____

   d. _____

9. In relation to communicable disease, how would you describe a “susceptible” or “non-immune” person”?

10. Communicable diseases acquired by inhaling the causative agents are classified as _____ diseases.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 1

1. The prevalence of disease in peacetime (para 1-3)

2. Military mission (para 1-4c)

3. Those illnesses that can be transmitted from human to human or from animal to human (para 1-5a)

4. The period of time between infection and the onset of signs and symptoms of the disease (para 1-6a)

5. a. Clinical procedures
   b. Laboratory procedures (para 1-6b)

6. The broad range of differences experienced by people in a group, all having the same illness. The range is from the very ill to the barely ill. (para 1-6c)

7. a. The reservoir (the source)
   b. The vector (means of transmission)
   c. The individual susceptible to the disease (para 1-7a)

8. a. Isolation
   b. Quarantine
   c. Medical surveillance
   d. Treatment (para 1-8d(1) through (4))

9. A “susceptible” or “nonimmune” individual is one who has little resistance against a particular disease organism. If exposed to this organism, he is like to contract the disease. (para 1-8f)

10. Respiratory (para 1-9b)

End of Lesson 1

LESSON ASSIGNMENT

LESSON 2	Food- and Water-borne Diseases
LESSON ASSIGNMENT	Paragraphs 2-1 through 2-15
LESSON OBJECTIVES	After completing this lesson, you should be able to:

2-1 Identify the infectious agents responsible for selected food- and water-borne diseases.

2-2 Recognize the mechanisms by which food- and water-borne diseases are spread.

2-3 Select the appropriate measures for preventing and controlling food- and water-borne diseases.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 2

FOOD- AND WATER-BORNE DISEASES

Section I. THE DISEASES

2-1. GENERAL

a. **Diseases of Military Importance.** The food- and water-borne diseases of military importance include bacillary dysentery, the various food poisonings, typhoid and paratyphoid fever, cholera, unclassified diarrhea, hepatitis, and some of the protozoan (one-cell animal) and helminthic (worm) infestations. Because of its particular military significance and various means of transmission, hepatitis will be discussed in a separate lesson (lesson 7).

b. **The Reservoir**. The reservoir for most of these diseases is the human carrier. Animals also serve as reservoirs for some.

c. **The Source**. The source of infection is infectious excreta or other discharges from humans or animals.

d. **Transmission**. Transmission most often occurs when food and, to a lesser extent, water contaminated with infectious excreta are consumed.

- Important in the transmission of these diseases are the so-called Five F Factors: feces, fingers, foods, flies, and fluids. See Figure 2-1.

- Food and water may be fecally contaminated in several ways.

-- Leaky or improperly installed sewer lines in kitchens or near water sources account for some.

-- Raw excreta or improperly treated sewage may also contaminate water sources.

-- Flies and other arthropods may carry infectious agents from sewage or dumps to foods.

- In most areas of the world, human excreta is used to fertilize foodstuffs.

e. **Transmission in the Army**. Within the Army, however, the mode of transmission most commonly found is the contamination of food by infected or contaminated food handlers.

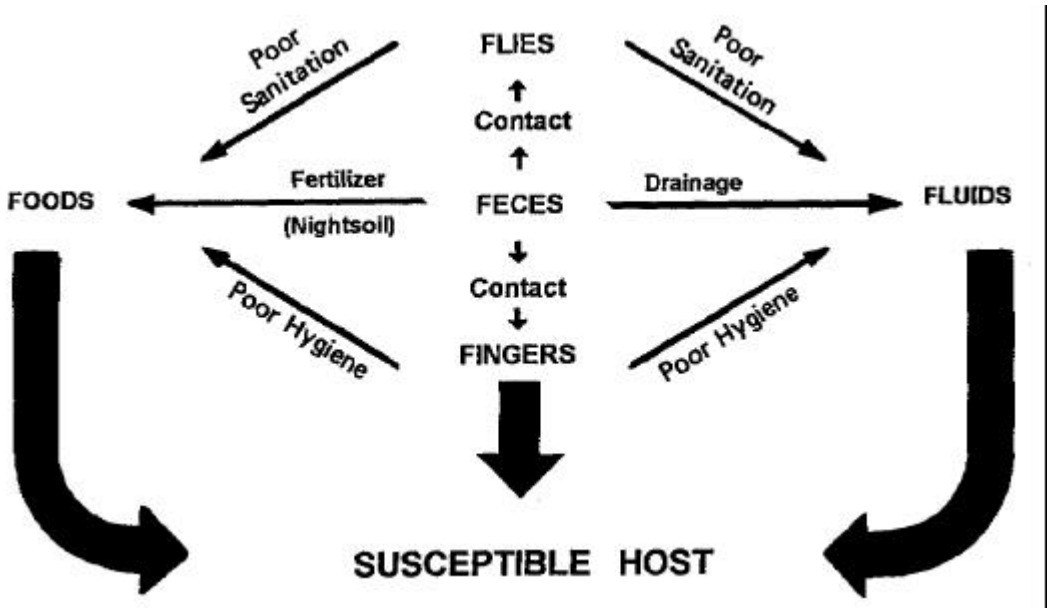


Figure 2-1. The five "F" factors.

2-2. MILITARY IMPORTANCE

a. **Peacetime Food-Borne and Water-Borne Disease**. In peacetime, high levels of environmental sanitation and personal hygiene on the part of Army personnel and nearby civilian populations combine to hold the incidence of food- and water-borne diseases to a minimum.

- In 1962, gastroenteritis and food poisoning totaled 15,623 cases for the Army, and in 1963, 14,862.

- This is an average of about 13 cases per thousand per year.

b. **Current Disease Rate**. Of late, about 90 percent of admissions for intestinal disease are for bacillary dysentery or some type of food poisoning.

c. **Wartime**. In time of war, mobilization, or catastrophe, the intestinal disease problem is magnified.

- In the first several months of any past war, the incidence of intestinal disease has risen to very high levels and contributed to a high degree of non-effectiveness.

- This pattern is expected to hold for any future campaign.

d. **Example: German Troops at El Alamein**. The experience of the German Afrika Korps in World War II exemplifies the consequence of a breakdown in sanitary discipline.

- In October, 1942, Montgomery's 8th Army engaged Rommel's Afrika Korps at El Alamein in what was probably the decisive battle of North Africa.

- During September, October, and November of that year, admissions to field medical stations for dysentery or diarrhea totaled only 2.5 percent of the 8th Army strength, but the figure for the Afrika Korps was 20 percent.

- From 40 to 50 percent of Germans affected were frontline troops.

- Their campsites were filthy. Large amounts of feces lay on the surface of the ground.

- At the beginning of the battle, Rommel himself was on convalescent leave in Germany recovering from amebic dysentery and hepatitis.

--RESULT--

Although the 8th Army would have outnumbered the Afrika Korps at least 3 to 1 if all personnel had been fit, Rommel nevertheless credited the defeat of his command not to the 8th Army, but to dysentery.

e. **Example: US Army Airborne Brigade in Lebanon**. The experience of a United States Army Airborne Brigade in its 3-month occupation of Lebanon during the warm months of 1958 shows the consequences of consuming unapproved foods and beverages.

- Initially, C rations were the only foods consumed, and troops were confined to olive groves away from the civilian population.

  -- No diarrhea or enteric diseases became apparent during that time, even though field sanitation facilities and practices left much to be desired then and throughout the operation.

- Later, B rations were introduced, and troops were permitted to visit civilian communities, where many ate the local food and beverages.

  -- Enteric (intestinal) diseases soon became a problem.

  -- The incidence increased until as many as 85 men per 1,000 were reporting weekly to dispensaries for diarrheas and dysenteries.

-- In addition, stool specimens from 2,200 apparently healthy soldiers were obtained in Lebanon; 85 of these were found to be positive for Shigella (para 2-6) contracted in Lebanon.

2-3. THE FOOD POISONINGS

Food poisoning is distinguished from other food-borne diseases by its relatively abrupt onset and violent symptoms.

a. **Incubation Time/Severity of Disease**. The incubation time and severity of disease are related to the amount of contaminated food consumed. Typically, the larger the amount of toxic agent consumed, the shorter the incubation time and the greater the severity of symptoms of the particular type of food poisoning.

b. **Comparison with Other Diseases**. In other diseases transmissible by ingestion of the causative organism, the mode of entry of the etiologic agent has little influence on the typical incubation periods, courses, and outcomes of the diseases.

- For example, diphtheria acquired by ingestion of contaminated milk is not remarkably different from diphtheria acquired through inhalation of C. diphtheriae.

c. **Food Poisoning Breakouts**. Recognizable outbreaks of food poisoning are most often seen among people who have eaten food from a common source, such as a dining facility, restaurant, or field kitchen.

- Outbreaks are more numerous in hot weather, when picnic groups often fail to guard against food poisoning.

- Prevention of food poisoning is discussed in section II.

d. **Chemical Intoxication.** A chemical intoxication, or poisoning, is caused by swallowing a harmful chemical substance.

- The most common poisons in military situations are pesticides and heavy metals. They are usually the result of labeling and/or storage errors.

-- When zinc galvanized garbage cans are used for the production or storage of acid foods such as lemonade or tomato juice, the zinc metal is ionized; zinc ions cause acute heavy metal poisoning.

-- Enamelware made from antimony or cadmium can also cause heavy metal poisoning when used in the preparation of acid foods.

- The symptoms of chemical poisoning vary according to the poison involved; however, most poisons cause:

  --Nausea
  --Vomiting
  --Abdominal pain
  --Diarrhea

- The onset of symptoms is usually brief and characterized by the simultaneous occurrence of many cases.

- Treatment varies with the particular poison, but usually includes the following general principles:

  -- Evacuating the bulk of the poison from the stomach and intestinal tract by lavage (irrigation), emetics, and/or cathartics.

  -- Administration of appropriate antidotes to neutralize the poison.

  -- Eliminating poison already absorbed, by hydration, dialysis, or other methods.

  -- Symptomatic treatment as indicated.

e. **Bacterial Intoxication**. Two important types of intoxication are caused by ingesting toxins formed by bacteria acting on foods: staphylococcal intoxication and botulism.

(1) Staphylococcal intoxication. Almost 80 percent of all reported outbreaks of gastroenteritis in the United States belong to this group.

- Causative agent. The causative agent is a toxin produced by certain strains of staphylococci.

- Signs/symptoms. The illness is characterized by an abrupt and sometimes violent onset with severe nausea, vomiting, prostration, and sometimes-severe diarrhea. The symptoms occur shortly after eating contaminated food.

- Incubation period. The incubation period is short, average 1 to 6 hours.

- Diagnosis. There are no satisfactory laboratory tests that can aid in the actual diagnosis; however, if specimen of all foods can be obtained for culture, the finding of staphylococci is suggestive.

- Prognosis. The disease is usually mild, rarely producing death.

- Location of bacteria. Staphylococci are frequently found in secretions of the normal nose and throat, and often in great numbers, consequently, of a sinus infection.
- Infections caused by these bacteria. Staphylococci are usually the cause of skin infections such as boils and infected hangnails.

- Foods that may contain this bacteria. Foods that may cause staphylococcal food poisoning are chiefly:

  -- Meats (particularly cured ham)
  -- Pastries containing custard or cream fillings
  -- Puddings

- Treatment. There is no known specific treatment.

(2) Botulism. Botulism is a highly fatal, afebrile (without fever) disease caused by the toxin produced by *Clostridium botulinum*.

- Attack on body. The toxin attacks the central nervous system, and rarely do acute gastrointestinal disturbances occur.

- Incubation period/symptoms. The incubation period is usually 18 to 36 hours. Early symptoms include fatigue, headache, dizziness, and double vision.

- Prognosis. These early symptoms are followed by progressive muscular weakness; in addition, an ascending paralysis until the brain is readied. Death may occur in 3 to 7 days.

- Reservoir. Soil and the intestinal tracts of animals are reservoirs for the bacillus.

- Source of poisoning The immediate source of poisoning results from uncooked or poorly cooked food of low acid content being kept in an anaerobic (no oxygen) environment, such as in cans.

  -- Most cases in the U.S. are caused by home-canned vegetables; therefore, the disease is very rare in the military services.

  -- In Europe, especially, most cases can be traced to sausages or other smoked or preserved meats.

- Treatment. Specific therapy includes the use of botulinus antitoxins as well as respiratory support.

-- ATTENTION --

Artificial respiration may be necessary.

f. **Bacterial Infections**. The following food-borne diseases, while commonly referred to as food poisoning, are not true intoxications, but bacterial infections caused by the actual colonization of the infectious organism within the human body:

(1) Salmonellosis (Salmonella food poisoning)

- Identification. All of the Salmonella species of bacteria that affect man are capable of inducing acute gastroenteritis, fever, or septicemia (invasion of the bloodstream). Discussion in these paragraphs is limited to acute gastroenteritis-salmonella food poisoning, which is actually an infection.

- Signs/symptoms. This commonly occurring disease is characterized by diarrhea and abdominal cramps. Often nausea, vomiting, and fever are also present. The incubation period may range from 6 to 48 hours, with 12 hours being the usual.

- Prognosis. The acute gastroenteritis may develop into enteric fever or septicemia. Recovery of Salmonella from suspected food or from feces of cases during the acute stage of infection aids diagnosis.

- Reservoir. Man, as both case and carrier, is a reservoir, as are most domestic animals, especially fowl, and many wild animals.

- Source of infection. Sources of infection, in addition to feces of infected humans and animals, include: eggs, dried egg powder, and undercooked flesh of infected animals. Routine veterinary-meat-inspection-techniques usually can detect the disease in large meat animals, but not in fowl. Eggs and other foods may be contaminated by food handlers, rats, and insects.

- Treatment. There is no specific therapy.

(2) Clostridium perfringens “food poisoning.”

- Identification. *Clostridium perfringens (C. welchii)* is an organism that is found widely distributed in nature and which is part of the normal flora of the human bowel. It is considered pathogenic (causing disease) only when several of the organism are ingested and permitted to grow in the upper digestive tract.

- Incubation period. The incubation period is approximately 8 to 24 hours.

- Signs/symptoms. The onset of the disease is characterized by abdominal pain, followed by diarrhea, and sometimes by nausea and vomiting. The disease is usually a mild, self-limiting disease lasting from 2 to 24 hours.

- Treatment. The only treatment required is supportive care.

- Reservoir. The reservoirs of the disease are man, cattle, pigs, and rodents.

- Source of infection. Food contaminated with infected feces is the immediate source of infection. Foods containing meat--usually meat pies, stews, and reheated meats--are those most commonly associated with outbreaks.

2-4. TYPHOID FEVER

Typhoid fever is a systemic infection.

a. **Signs/Symptoms**. Clinical signs include a continued fever, enlargement of the spleen, and rose spots on the body trunk. Constipation is more common than diarrhea, but either may occur. Antibiotic therapy has reduced the case fatality rate to near zero.

b. **Incubation Period/Cause**. The incubation period usually ranges from 1 to 3 weeks, with 2 weeks the usual. The causative agent, *Salmonella typhi* (there are at least 50 types), is discharged in the feces or urine of infected persons, including healthy carriers.

c. **Transmission**. Typhoid is transmitted by ingestion of shellfish taken from sewage-contaminated beds, raw fruits and vegetables fertilized by night soil, and contaminated milk and milk products. The disease is widespread throughout the world and is especially prevalent in wartime or during floods.

- During such periods, typhoid carriers in the general population are more likely to become food handlers and sewage is more likely to become mixed with water used for drinking by humans.

- Despite routine administration of triple vaccine to United States Army troops, more than 500 became typhoid fever cases during World War II.

- Flies sometimes are mechanical vectors.

d. **Reservoir**. Typhoid bacilli multiply rapidly in milk and other food and may survive several weeks in cheese and butter, 7 days in well water, and throughout the winter in frozen soil. They are killed, however, when subjected to a temperature of 60° C (140° F) for 15 to 20 minutes.

e. **Destroying the Typhoid Bacilli.** A search for typhoid bacilli in water supplies is impractical. Instead, finding another bacterium, *Escherichia coli*, which is a normal inhabitant of the human digestive tract, is presumptive evidence of fecal pollution of water. When *E. coli* is found in water, the water is considered contaminated and a possible vehicle for typhoid fever and other diseases for which human excreta is the source of infection.

f. **Treatment**. Chloramphenicol is used as specific therapy. The patient should be isolated in a fly proof room. Immunization is considered less important than environmental sanitation.

g. **Control Measures**. In addition to the control measures discussed in section II, the following should be carried out:

- Trace and treat contacts and carriers

- Exclude cases, carriers, and familial contacts from food handling until cultures of feces and urine are negative for typhoid bacilli.

- Maintain medical surveillance of patients for at least one month after onset and then until cultures of feces and urine are negative.

2-5. CHOLERA

a. **Identification**. Cholera is an acute bacterial infection of the intestine. It is presently endemic in Asia, Africa, and the Americas. It may spread along the routes of trade to any area of the world.

b. **Signs/Symptoms**. In severe cases, the disease is characterized by sudden onset of vomiting, profuse watery diarrhea (“rice water stools”), rapid dehydration, and collapse. The patient may die within a few hours after onset.

c. **Epidemics**. In epidemics, which tend to occur explosively, the fatality rate among untreated cases may be as high as 70 percent.

- Epidemics, like those of typhoid, usually are precipitated by widespread consumption of water contaminated with human feces or vomitus containing the causative bacilli Vibrio cholerae.

- Such epidemics are frequently associated with floods and other emergency situations.

d. **Transmission/incubation Period**. Thereafter, transmission is continued by contaminated food handlers and flies with carriers being of little importance. The incubation period is usually less than 3 days but may vary to 7 days. Cases and convalescents usually remain infectious from 7 to 14 days after onset of symptoms.

e. **In the Military**. The almost total absence of cholera in American troops during World War II is attributed to the combined effects of two factors, natural host resistance and good sanitation; however, the potential danger of our troops or advisors stationed in endemic areas should not be taken lightly. Besides the control measures discussed in section II, following preventive and treatment measures are indicated.

f. **Prevention**

(1) Strict isolation of patients and carriers is not necessary; however, the patient's clothing, bedding, and eating utensils should be disinfected by boiling or autoclaving. Woolen blankets need not be boiled; they may be decontaminated by laundering, drying, and exposing both surfaces to the sun for several days.

(2) Particular care should be taken to avoid pollution of water supplies in the disposal of excreta and vomitus and all articles, which are contaminated by them.

(3) Attendants should thoroughly wash their hands with soap and water and disinfect them with an antiseptic solution immediately after handling patients or any article contaminated by them.

(4) Contacts should be under medical surveillance for at least 5 days from last exposure, or longer if their feces contain the cholera bacilli.

(5) Unreported cases and foci of infection, such as water sources and foodstuffs, should be sought.

(6) Artificial immunization is of variable effectiveness and duration. It is required upon assignment to endemic areas and every 6 months while in such areas.

2-6. BACILLARY DYSENTERY (SHIGELLOSIS)

a. **Identification**. Bacillary dysentery is an acute inflammatory disease of the colon caused by members of the genus *Shigella*. These organisms are easily killed by direct sunlight, but they survive for considerable periods in water, ice, and the fecal discharges of active cases.

b. **Location**. Shigellosis occurs worldwide, being especially common in subtropical and tropical regions of the Orient.

c. **Transmission**. Transmission is by direct or indirect fecal-oral route. Those who do not clean their hands thoroughly including under their fingernails may spread the infection by touching others or by contaminating food.

d. **Signs/Symptoms**. When uncontrolled, it is a potent cause of disability. Typically, after an incubation period of a few days, the onset of the disease is abrupt and accompanied by fever, which may reach I04° F.

- Diarrhea appears promptly

- In severe cases, the feces may contain large amounts of blood, mucus, and polymorphonuclear leukocytes.

- In the fully developed severe form of the disease, the stools may ultimately consist of only frequently evacuated masses of sticky, bloodstained mucus, which contains enormous numbers of dysentery bacilli.

- Abdominal pain may be severe. The evacuations may be involuntary and accompanied by very painful straining. Bacillary dysentery usually is a self-limited disease, running its course in about 2 weeks.

- Many patients have only transient diarrhea or no intestinal symptoms. Shigellosis should be suspected from the clinical course, even though, mild cases with generally normal stools are common.

e. **In the Military**. In large groups of men, as in the military, the disease often smolders unrecognized for some weeks before it breaks out in a fashion, which attracts attention.

2-7. AMEBIASIS (AMEBIC DYSENTERY)

a. **Identification**. Amebic dysentery (Figure 2-2) may be acute or chronic, with an incubation time varying from a few days to several months. It is caused by an ameba, *Entamoeba histolytica*, which lives in the colon of man.

b. **Development.** A resistant form (cyst) of this protozoan (single celled animal) is passed in the feces. Susceptibles ingest the cysts with food or water containing the cysts. The active form (trophozoite) then breaks out of the cyst and invades the large intestine, where it multiplies. It may also spread via the bloodstream to the liver, lungs, brain, and skin.

c. **Signs/Symptoms**. Symptoms, which vary in character and severity, may be present in one of three recognized forms:

- Abdominal discomfort and diarrhea, alternating with constipation

- Chronic diarrhea

- Acute dysentery, in which the amount of blood and mucus passed, is marked, but pus is scant.

NOTE: This contrasts with pus passed in cases of bacillary dysentery.

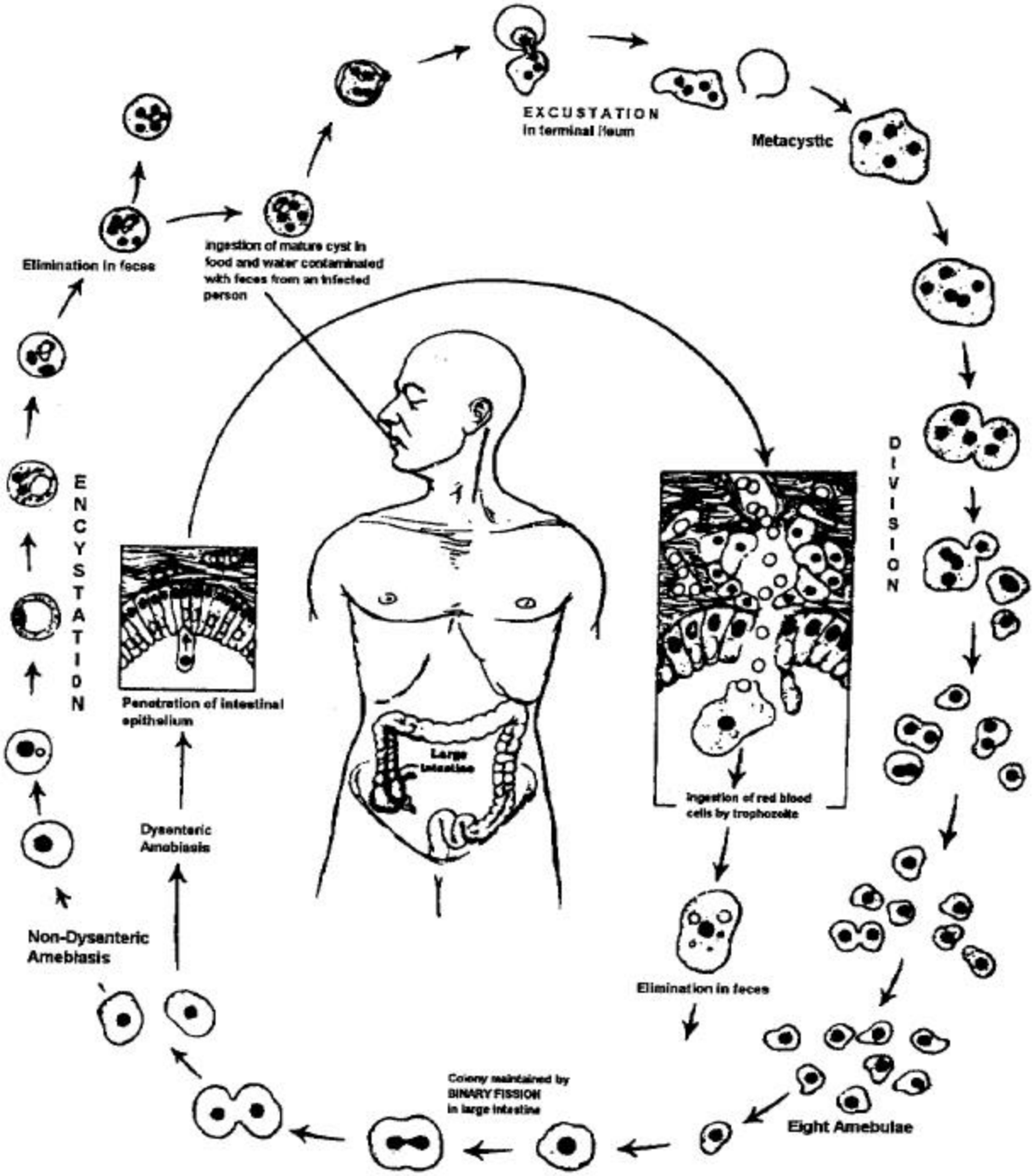


Figure 2-2. Life cycle of Entamoeba histolytica, the agent, which causes amebic dysentery.

d. **Location**. Amebiasis occurs worldwide, especially in tropical countries. As many as 50 percent of the people in unsanitary areas may be affected. It is estimated that in the United States alone, 5 to 10 percent of the population are carriers of the parasite. The carrier-state, which may continue for years, is very important in the perpetuation of the disease.

e. **Treatment**. There is no specific therapy for amebiasis. Instead, multiple drugs are employed, the exact ones being determined by the severity and localization of the disease within the body.

f. **Immunity**. There is no artificial immunity; recovery from attack apparently does not confer immunity.

g. **Drinking Water**. Water for drinking should be subjected to diatomite filtration, then chlorinated to five parts per million (ppm) chlorine residual after a 30-minute contact time. Where diatomite filtration is unavailable, water in individual canteens should be treated by dissolving 2 iodine tablets in 1 quart of water. Canteen threads should also be disinfected by partially unscrewing the cap, inverting it, allowing iodized water to flow over the threads, recapping, and allowing the water to stand 30 minutes before consumption.

h. **Night Soil Fertilizer.** Consumption of fresh foods grown in fields fertilized with night soil (human feces) should be avoided (para 2-14b(8)).

2-8. TRICHINOSIS

a. **Identification**. Trichinosis (Figure 2-3) is a parasitic (helminthic) infestation of man, hogs, rats, bears, marine mammals, and other omnivorous animals. The causative agent is *Trichina spiralis*, a tiny nematode (roundworm). Man contracts the disease only by eating the meat of animals, chiefly pork, containing living trichinae.

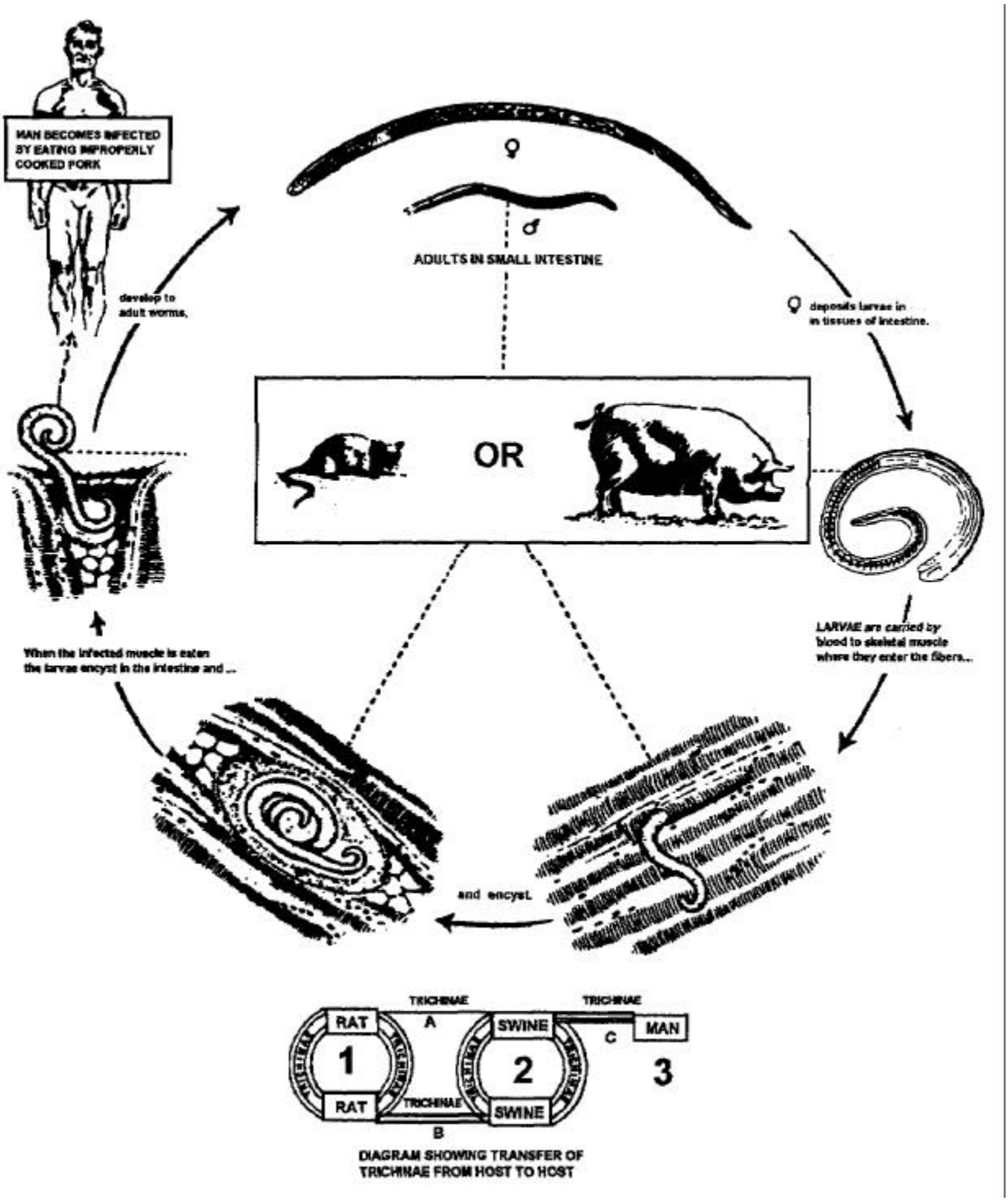


Figure 2-3. Life cycle of Trichinella spiralis, the garbage worm, the agent that causes trichinosis.

b. **Life Cycle of Trichina Parasite**. Briefly, the life cycle of the Trichina parasite is as follows:

- Adult worms live in the gastrointestinal tract of the host (man or animal).
- The female worm passes larvae, which penetrate the intestinal wall.
- The larvae are then carried throughout the body by the bloodstream, and thus may be found in any organ of the body.
- When they reach muscle--principally the heart, tongue, diaphragm, and skeletal muscles--the larvae encyst, where they remain viable for months.
- When meat containing viable encysted larvae is eaten, the cyst is dissolved by the digestive juices, thus releasing the larvae, which grow to maturity and reproduce in the intestines.

c. **Incubation Period**. The incubation period is from 2 to 28 days after the ingestion of infected meat, with 9 days the usual.

d. **Signs/Symptoms**. Symptoms include:

- Fever
- Gastrointestinal disturbances
- Muscle soreness
- Pain
- Swelling of upper eyelids
- Thirst
- Profuse sweating
- Chills
- Prostration
- Others are widely varied both in-kind and severity
- The disease occasionally results in death.

e. **Location**. Trichinosis occurs worldwide and is more widespread in the countries where hogs are commonly fed garbage containing meat scraps, than in countries where hogs are raised principally on root vegetables.

f. **Control Measures**. Control measures include thorough cooking of pork and meat from wild animals before consumption, and boiling garbage before feeding it to hogs. Rodent control is also important, since rats and other rodents are natural animal hosts.

g. **Treatment.** Since most cases recover without treatment, treatment is supportive. A drug such as mebendazole or thiabendazole may be prescribed.

2-9. PARASITIC WORM INFESTATIONS

a. **Roundworms (Ascariasis).**

(1) Identification. The most common parasitic infestation in the world is ascariasis, or infestation with the nematode (roundworm) *Ascaris* l*umbricoides*, the large roundworm of man.

(2) Location. It is estimated that about one billion people throughout the world are infested with the worm. Occurrence is greatest in moist, tropical countries, where half the population may be affected. In the United States, the disease is most prevalent in the South.

(3) Signs/symptoms. The adult roundworm usually lives within the gastrointestinal tract of the human host. The disease is usually mild; however, heavy infestations may cause digestive disturbances, abdominal pain, vomiting, restlessness, and disturbed sleep. Complications occur when the adult worm migrates into and obstructs the bile duct or the pancreatic duct of the host.

(4) Reservoir. The reservoir of the disease is the infected human, who passes the eggs in his feces.

- Under favorable conditions, the eggs may live in soil for months or even years.

- Infection occurs when a person eats food contaminated with soil or other infective material containing Ascaris eggs.

- The eggs hatch in the intestine, after which the larvae penetrate the intestinal wall and travel, via the lymphatic and circulatory systems, to the liver and lungs.

- From the lungs, larvae pass into air passages, ascend the bronchi, and are swallowed, eventually reaching the small intestine, where they mature and mate.

- The female worm produces about 200,000 eggs a day over her life span of less than a year (most live less than 6 months).

(5) Treatment. Drug therapy is effective in removing the adult stage of the worm; however, surgery may be required to remove obstruction caused by abnormal migrations.

(6) Control measures. Control measures consist primarily in:

- Educating persons in proper hygienic habits

- Preventing the fecal contamination of soil around houses or where vegetables are grown

- Thoroughly cooking or otherwise disinfecting all vegetables before eating them, especially in areas of the world where “night soil” is used as fertilizer

b. **Tapeworms (Taeniasis)**

(1) Identification. There are several tapeworms (*Cestoda*) that affect man. The two most common of these parasites are the beef tapeworm, Taenia saginata, which is widely distributed in the United States; and the pork tapeworm, *Taenia solium*, which is rare in the United States. However, they are common in Mexico, Peru, East Africa, and Eastern Europe. The disease caused by these helminths may occur in two forms: one is *taeniasis*, a harmless intestinal infestation that is nonfatal and often asymptomatic; the other is a severe disease of high fatality, known as *cysticercosis*.

(2) Life cycle. The life cycles of both *T. saginata* and *T. solium* require an intermediate host, except that eggs of *T. solium* may be passed from man to man.

- The adult worm lives in the intestine of man, and eggs are passed with the feces.

- When cattle, in the case of *T. saginata*, or hogs, in the case of *T. solium,* eat grass or other foodstuffs contaminated with the feces of infected humans, the eggs are ingested and hatch in the intestines of the animal.

- The larvae, upon emerging from the eggs, migrate to the striated muscles, where they encyst.

- When man eats infected beef or pork, which has been improperly cooked, the encysted larvae develop into adult worms.
- Normally, only one worm reaches maturity, but it may remain in the intestine for 30 to 40 years if untreated, reaching a length of up to 10 meters (T. saginata) and producing eggs as long as it lives.

(3) Clinical symptoms. The clinical symptoms of infestation by the adult worm may be absent but, when present, include:

- Nervousness
- Insomnia
- Loss of weight
- Abdominal pain
- Digestive disturbances

(4) Incubation period. The incubation time is from 8 to 10 weeks.

(5) Special problems of T. solium. The adult parasite can be eliminated by the use of drugs. *T. solium*, which is rare in the United States and Canada, presents a special problem, in that the eggs may be passed from person to person by means of contact with contaminated feces.

- When the eggs are ingested, they hatch in the intestines, and the larval forms (cysticerci) develop in the subcutaneous tissues, striated muscles, and other parts of the body.

- When cysticerci develop in the eye, heart, or brain, the results are quite serious, frequently resulting in death.

(6) Treatment. There is no specific treatment for cysticercosis, but surgery may sometimes be employed to remove the cysts.

(7) Control measures. The control measures for prevention of tapeworms consist in:

- Thorough cooking of all suspect meat before consumption

- Prevention of the contamination of soil and vegetation by the feces of infected humans

2-10. FLUKE INFESTATIONS

a. **Identification.** Flukes (trematodes) are parasites of the class *Trematoda* which are pathogenic to various animals, including man. Clinically, the flukes may be classified into four groups:

- Intestinal flukes
- Liver flukes
- Lung flukes
- Blood flukes

The blood flukes are not acquired essentially through food and drinking water, although, they may occasionally be contracted by this means. Therefore, they will be discussed separately.

b. **Life Cycle**. (See Figure 2-4.) The flukes are characterized by a complicated life cycle involving several forms and requiring (usually) two intermediate hosts.

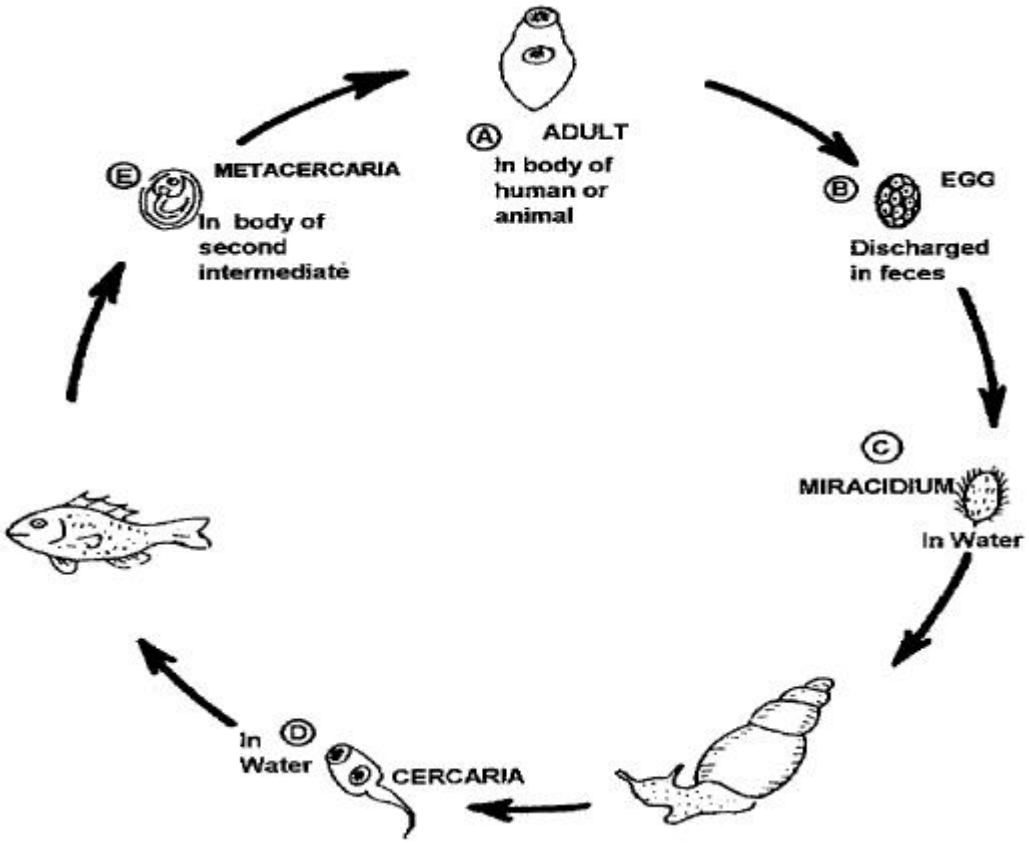


Figure 2-4. Life cycle of a typical fluke.

- Typically, the adult parasite, which resembles a flat, leaf-shaped worm, lives in the body of the definitive host--man or animal.

- Eggs, when passed in the feces of the host, require water to survive.

- The eggs hatch to liberate free-swimming miracidia, which must penetrate the body of an intermediate host (snail) or perish.

- In some cases, the miracidium is eaten by the snail. Within the body of the snail, miracidia develop, sometimes through several generations, into cercariae--free-swimming larvae that leave the snail and seek either a second intermediate host where they encyst as metacercariae, or as in the case of Schistosoma a definitive host whose intact skin is penetrated by the cercariae.

- The cercariae then migrate to their final body organs and develop into adults.

- The second intermediate host is a fish or crab. In one genus of flukes (*Fasciola),* the cercariae encyst as metacercariae on vegetation.

- When man or other definitive host eats infected crabmeat, fish, or vegetation, the metacercariae are ingested and hatch in the intestine.

- The young worms then migrate to various organs of the host's body, where they mature and produce eggs, which are passed with the host's feces to start the cycle again.

c. **Signs/Symptoms**. Symptoms of fluke infestations vary according to the organ affected and the severity of the infestation.

- Intestinal infestations are often asymptomatic, or they may cause abdominal pain and diarrhea.

- Lung fluke infestations may cause coughing, blood in sputum, pain in the chest, and muscular weakness.

- Liver flukes may cause pain in the liver area, abdominal pain, diarrhea, fever, anemia, and wasting of the body.

d. **Treatment**. Continued untreated infestation may lead to cirrhosis, jaundice, and liver failure. The lungs, brain, or other tissue may be affected.

e. **Prevention**. Prevention consists in thoroughly cooking all fish, crabs, and aquatic plants before eating them.

f. **Location**. The flukes are common throughout the Orient, Asia, India, parts of South America, and many Pacific islands. Table 2-1 lists the common food-borne flukes affecting man, according to the causative organism, the organ affected, the intermediate hosts, and the area of prevalence.

TREMATODE (DISEASE)	DEFINITIVE HOST	SITE OF INFESTATION	INTERMEDIATE HOST	AREAS OF PREVALENCE
Fasciolopsis busci (fasciolopsiasis)	Man Pig	Intestine	Snail-metacercariae	The Orient, especially China
Fasciola hepatica (fascioliasis)	Man Sheep Cattle Goats	Liver	Snail-metacercariae encrust on vegetation	Worldwide
Paragonimus westermani (paragonimiasis)	Man	Lungs	Snail-crab	The Orient Africa Peru Ecuador Philippines Indonesia
Clonorchis sinensis (clonorchiasis)	Man Cats Dogs	Liver (bile duct)	Snail-fish	China Japan Korea
Heterophyes heterophyes (heterophyiasis)	Man Cats Dogs Birds	Intestine	Snail-fish	The Orient

Table 2-1. Common food-borne trematodes (flukes)

2-11. SCHISTOSOMIASIS (BILHARZIASIS)

a. **Identification**. Schistosomiasis is a parasitic disease caused by a blood fluke or schistosome infestation. This disease is not primarily a water-borne disease; however, it may be acquired by drinking water that is contaminated by the cercariae of schistosomes.

b. **Military Importance**. Three etiologic agents are of military importance: *Schistosoma mansoni, S. haematobium*, and *S. japonicum*.

- The military reoccupation of the Phillippine island of Leyte in late 1944 was the setting for paractically all the schistosomiasis acquired by United States troops during World War II.

- Approximately 1,500 cases of *Schistosoma japonicum* are known to have resulted from military or other operations on Leyte.

- As far as is known at the present, no cases of *Schistosoma mansonia* resulted from military or other operations during World War II.

- However, infection of American troops of Puerto Rican origin is quite common, and eggs of *S. mansonia* are quite frequently found in routine stool examination of such persons after entry into the military service.

- In the majority of these cases, the condition is asymptomatic, but it is of military significance in that these soldiers may require treatment and sometimes hospitalization.

c. **Life Cycle of Schistosomes**. Schistosomes are modified forms of flukes. The life cycles of the three species of Schistosoma are very similar to those of other flukes.

(1) Adult female worms. The adult female worms:

- Lodge in the veins of infected humans and domestic and wild animals, including rodents and monkeys.

- Lay eggs that ultimately find their way into feces or urine

- If these eggs gain access to fresh water, the first intermediate host (a particular species of snail, different for each worm) may become infected either by eating the eggs or by being penetrated by the larva (miracidia) that emerge from the eggs as free-swimming cercariae.

(2) In the snail. Within the snail:

- Many cercariae develop, which then escape from the snail and go back into the water.

- As many as 100,000 cercariae (the form infective for man) may be formed from a single miracidium.

(3) Adult flukes in humans. The free-swimming cercariae may then enter man directly through the skin or mucous membranes (while the person is drinking, working in, walking in, or swimming in contaminated water).

- The adult flukes then develop within the human blood vessels.

- Eggs attached to the vessel walls cause lesions and tissue necrosis.

- The worms may lodge in the vessels of many of the major organs.

- The worms are usually found in those serving the mesentery, intestines, and pelvis, depending, to some extent, on the species of the schistosome parasite.

d. **Clinical Symptoms of Schistosomiasis.**

(1) Early symptoms. Early symptoms are variable both in the time of their appearance and their intensity, and they may appear at any part of the body.

- Itching and rash may occur immediately after exposure.

- Three to 10 weeks (commonly 5 to 6) later, a variety of general symptoms may impair the soldier's ability to function effectively and may last for from 2 to 10 weeks.

(2) Remission and relapses. There may be remissions and relapses, but early symptoms ultimately disappear in most cases if reinfection does not occur.

(3) Later symptoms. After a number of years, late symptoms of various kinds appear in the circulatory, respiratory, digestive, or nervous systems separately or in combination. Wasting away may be extreme.

NOTE: Without treatment, schistosomes may persist and reproduce in the body for up to 30 years.

e. **Prevention.** Under combat conditions in endemic areas, the avoidance of cercariae-infested water is often difficult or impossible; however, certain precautions can be taken by individuals to prevent or reduce chances of infection.

(1) Preventive measures

- Clothing, especially if it has been impregnated with arthropod-repelling compounds, serves as a fairly effective barrier.

- Trousers should be tucked into the tops of boots and as much of the skin covered as possible.

- The application of standard issue insect repellent to exposed portions of the skin that may come in contact with infested water will give added protection for a short time.

- Surveys by trained personnel should be made as early as possible to locate infested bodies of water.

- Appropriate warning signs should be posted.

- Troops should be well indoctrinated as to the necessity for avoiding contact with infested water.

- Personnel required to handle or enter the water should be protected insofar as practicable by rubber hip boots, waders, -rubber gloves, or other waterproof clothing.

(2) Dealing with cercariae. The cercariae require only a few minutes to penetrate the skin.

- In case of wetting of an unprotected area of the body, the immediate application of any available disinfectant, soap, or even a brisk rubbing of the skin with a towel or article of clothing may reduce the chance of infection.

- Where possible, water used for laundry or bathing by small units away from their base should be taken from subsurface sources.

- Surface water should be processed if a subsurface source is not available.

- Holding water in storage for 72 hours after its removal from surface sources, and in the absence of the snail vector, will eliminate the cercariae.

- If this is not feasible, Lyster bags of adequately treated water can be used for bathing. Availability of such facilities will minimize infractions of bathing discipline.

(3) Sanitary discipline. Inasmuch as the infection of any given snail population has resulted from the pollution of the water by feces coming from infected animal as well as human hosts, the control of schistosomiasis by enforced human sanitation has limitations.

- Nevertheless, strict sanitary discipline should be maintained, not only because of its possible value in the eventual prevention of schistosomiasis, but for the more immediate reduction of other communicable diseases.

- Obviously, where proper sanitation methods are practiced with no defecation or urination into water supplies, there is little chance of transmission of this disease.

Section II. CONTROL MEASURES OF FOOD- AND WATER-BORNE DISEASES

2-12. GENERAL

a. Control measures for the prevention of food- and water-borne diseases are aimed at breaking the chain of disease transmission.

b. If any link in this chain is broken, the spread of disease will be arrested. For any given disease, there is always one link that is more vulnerable and most easily broken. However, it is always best to attack all three links, thereby intensifying our efforts at prevention to the maximum extent possible. One measure, which is applicable to all three links, is personal hygiene. If good principles of personal hygiene are applied throughout the chain of disease transmission, few problems with communicable diseases will be encountered.

BREAKING THE CHAIN of COMMUNICABLE DISEASE TRANSMISSION
Apply the principles of personal hygiene

2-13. MEASURES APPLICABLE TO THE SOURCE

a. **Food- and Water-borne Diseases are Filth Diseases**. Human body discharge--feces, urine, and, to a more limited extent, sputum and the content of skin lesions--are the principal sources of intestinal infections. Control of these diseases rests primarily with prevention of excreta-to-mouth transmission.

b. **Human Feces and Urine Disposal**. Disposal of human feces and urine must be accomplished in a sanitary manner. On a post with a sanitary sewage system that includes an adequate sewage treatment plant, excreta containing the most virulent of disease agents can be placed directly into the system in safety and without prior disinfection. In the field, proper construction, maintenance, use, and closure of field latrines must be enforced. Walls, floors, grounds, clothing, and other articles soiled by cases and carriers of communicable diseases must be disinfected.

c. **Control Measures**. Patients sick with intestinal diseases communicable from man to man should be cared for in areas screened against flies and under such conditions of isolation as are warranted by the infection.

d. **Food Handlers/Kitchen Personnel.** Persons to be assigned or employed as permanent food handlers should be given pre-employment medical examinations.

- Persons known or suspected to be carriers of intestinal disease must be barred from food handling duty while they are infective.

- Food handlers with boils or open infections of the skin must not be permitted to handle food.

- Food handlers must not willfully conceal signs and symptoms of infection.

- Permanent food handlers returning to food handling duties after a continuous period of 30 days or more away from such employment for any reason must be given a medical examination before resuming food handling duties.

- It is the dining facility manager's responsibility, delegated by the commander through the dining officer, to inspect daily all kitchen personnel for signs of any illness, for lesions of the skin, and for general cleanliness and neatness.

- The food service supervisor should enforce rules of personal hygiene among food service personnel, including the following:

  -- Fingernails trimmed and clean

  -- Uniform clean, neat, and sufficient to cover the body trunk and armpits. A headpiece should be worn.

  -- Hand washing with soap and, preferably, hot water and a nailbrush after urinating or defecating, or after handling any unclean article. Hand washing in this way is one of the most effective general methods for the prevention of intestinal diseases.

2-14. MEASURES APPLICABLE TO THE VEHICLE

A number of measures can be taken to control/prevent the development of food- and water-borne diseases. In the paragraphs that follow, we will examine some of these measures.

PREVENTIVE MEASURES
against
FOOD- / WATER-BORNE DISEASES

- ✓ Water treatment
- ✓ Food stuffs
- ✓ Cleanliness of equipment and utensils
- ✓ Sanitary facilities
- ✓ Waste disposal
- ✓ Garbage
- ✓ Insect and rodent control
- ✓ Food service inspections

a. **Water Treatment.** Only water sources approved by the surgeon may be used. Water from these sources should be so purified that no pathogens exist in it and sufficient chlorine residual persists in the water distributed to troops.

b. **Foodstuffs**. Take care in handling food to keep it from becoming contaminated with pathogenic organisms.

- Most foods furnish sufficient nutrient matter for these organisms to multiply and in some instances to produce large amounts of toxin.

- The food service supervisor should inspect all foodstuffs arriving at the kitchen and refuse or hold for medical service examination any that appear unwholesome.

(1) Bacterial growth. Bacteria or their toxins are responsible for most outbreaks of food poisoning and for certain other intestinal diseases.

- Bacterial growth is slowed, although in many instances not stopped completely, at a temperature of 50° F.

- Bacterial growth increases quite rapidly as the temperature increases until a temperature is reached at which bacteria are finally destroyed (140°-165° F).

- The temperature range suitable for growth or the elaboration of enterotoxin may be referred to as the incubation range.

-- Obviously, foods, which require refrigeration for protection against bacterial growth, should be in the refrigerator at all times except when required elsewhere for efficient preparation and serving.

-- The operating temperature of the refrigerator should not exceed 45° F.

- Since enterotoxin-producing staphylococci may need only 3 hours of incubation at room temperature (70° F) to produce sufficient toxin to cause severe symptoms of food poisoning when ingested, 3 hours should be considered the maximum safe limit to allow perishable foods, especially those rich in protein, to remain unrefrigerated.

-- This time is cumulative.

-- For instance, 2 hours one time at room temperature and 1 hour later, even with intermittent refrigeration, equals the specified 3 hours.

- All cooked leftovers should be heated before serving. Remember that staphylococcus enterotoxin already formed in the food is known to be toxic after boiling for 30 minutes.

- Certain types of foods, such as macaroni pie or casserole and mashed or creamed potatoes, should not be saved under any condition, as heat--even at high cooking temperatures--does not penetrate to the center of the large food mass, despite many hours of heating in an oven.

(2) **Poultry and meats**. Poultry, stuffings, and stuffed meats should be heated throughout to a minimum temperature of 160° F, with no interruption of the initial cooking process.

- Poultry. Poultry should not be stuffed; dressings should be cooked separately.

- Pork and pork products. Pork and pork products, which have not been especially treated to destroy trichinae, should be cooked thoroughly to heat all parts of the meat to at least 150° F.

(3) Sandwiches. Bacteria, particularly staphylococci, thrive in sandwiches.

- Sandwich filling should remain in the incubation temperature range 50° to 130° F no longer than necessary.

- Moist bread is especially susceptible to bacteria; hence, bread should never be moistened when making sandwiches.

- Sandwich fillers such as ham, smoked or cured tongue, fried eggs, fish cooked or cured, sausage, and other perishables should be freshly prepared from materials that have been exposed to the incubation temperature but a few minutes.

(4) Perishable food. All potentially hazardous food should be protected from exposure to incubation range of temperatures for as short a time as possible.

- If served hot from steam tables, it must be kept at 140° F or above.

- refrigerated, the sum of the time intervals between refrigeration periods should be held to a minimum.

(5) Custards and puddings. All custards and puddings, and all foods with sweet, creamy fillings, including éclairs and cream puffs, are susceptible to bacterial growth.

- They should always be covered while cooling after cooking.

- They should be refrigerated at 45° F or below as soon after cooling as possible until serving time.

(6) Mixed foods. Egg salad, meat salads, any mixed salad containing eggs or finely divided meats, creamed foods, and creamed sauces are highly susceptible to bacterial growth and the production of toxins.

- They should be refrigerated except when being served and should be prepared as near serving time as possible.

- Foods of this type should not be held over from one meal to the next, nor should they be used in sandwiches.

(7) Milk and cream. Liquid whole milk, reconstituted milk, and cream delivered to the dining hall should be at a temperature 45° F or below when delivered.

- They should be refrigerated at once at a temperature of 45° F or lower, but not frozen.

- Unused milk left in opened single service or multi-service containers will be discarded.

- Leftover milk in unopened containers may be refrigerated, except that all leftover foodstuffs served to communicable disease patients will be discarded.

- Evaporated milk must be treated exactly like liquid whole milk once the container is open.

- Evaporated milk, like all other canned products, may safely be left in the can in which originally packed.

(8) Raw foods. Fresh fruits and vegetables grown in areas where human excreta is used as fertilizer, or where gastrointestinal or parasitic diseases may be expected to be prevalent, should not be consumed raw except with the approval of the surgeon.

- If approved, hard skinned fruits and vegetables with intact surfaces may be used after peeling.

- Leafy and other vegetables may be used after thorough washing and adequate disinfecting.

c. **Cleanliness of Equipment and Utensils**

(1) Clean and sanitize daily. All eating and drinking utensils must be thoroughly cleaned and sanitized after each use.

- All kitchenware and food contact surfaces of equipment (exclusive of cooking surfaces) used in the preparation of food or drink, and all food storage utensils, must be thoroughly cleaned after each use.

- Cooking surfaces of equipment must be cleaned daily.

- All items of equipment, which will come in contact with potentially hazardous foods, must be thoroughly cleaned and sanitized prior to such use.

(2) Operating mechanical dishwashers. Mechanical dishwashers should be operated to provide a 40-second wash period at a temperature range of 150°-160° F and a 10- to 15-second rinse period at 180° F for each rack.

(3) Manual dishwashing. If manual dishwashing is necessary, the recommended procedure is to use two sinks.

- One sink contains a wash solution (4-5 ounces of soap, laundry, and bar)

- Or a sink may contain 4 ounces of dishwashing compound, hand

- The sink should contain 10 gallons of water at a temperature as hot as is comfortable to the hands of the dishwasher (120° - 125° F).

- Follow the hand washing by a fixed nozzle spray rinse cabinet delivering--

- 10 gallons of 180° F water per minute at the manifold for 5 seconds; or--5 gallons per minute for 10 seconds.

- An alternative method is a third sink in lieu of the spray rinse cabinet with wire baskets used for immersion in the second and third sinks. Immersion in the third sink must be for 30 seconds at 180° F with a thermometer indicator and booster heater provided.

(4) Procedure for short supply of hot water. If adequate amounts of hot water cannot be obtained to accomplish manual or automatic dishwashing as described above, the following procedure is prescribed:

- Wash utensils in heated water containing soap or other detergents.

- Rinse in hot water.

- Immerse for not less than 1 minute in a sanitizing solution containing at least 50 ppm of available chlorine at a temperature of not less than 750F; or in a sanitizing solution prepared by following the instructions on the package of Disinfectant,

Food Service. Fresh solutions are required for rinsing and sanitizing utensils for each 100 persons.

(5) Utensils. All utensils must be air-dried. Storage racks must be designed to protect utensils from splash, dust, and other contamination.

d. **Sanitary Facilities**

(1) Toilet facilities. Adequate and conveniently located toilet facilities must • Toilet rooms must not open directly into any area used for food preparation or storage or for washing dishes and utensils.

- Toilet facilities, including rooms and fixtures, must be kept clean, well ventilated, and in good repair.

- Signs will be conspicuously posted reminding and directing all personnel to wash their hands after using the toilet.

(2) Hand washing. Hand washing facilities are required both in the toilet room and in the kitchen. These facilities will include lavatories equipped with:

- Hot and cold or tempered running water

- Hand-cleansing soap or detergent

- Individual towels or other hand drying devices

e. **Waste Disposal**

(1) Grease traps. Grease traps employed to intercept grease from kitchen wastes must be inspected periodically and maintained in a sanitary condition. Recovered grease should be placed in appropriate containers used only for that purpose and turned over to the appropriate agency for salvage or disposal according to local directives.

(2) Liquid waste. Liquid waste is normally handled adequately by the sewage system. The presence of liquid waste is evidence of inadequate functioning of the sewage system and warrants assistance and support by the installation engineer.

f. **Garbage**. Garbage consists of waste food or food products. Because of its organic composition, garbage is subject to rapid deterioration, odors, and bacterial growth. Unprotected garbage results in the attraction of flies, other insects, and rodents.

(1) Garbage containers. Garbage must be collected in tightly closed containers--normally galvanized iron containers with tightly fitted overlapping covers--placed on stands.

- Contents may not accumulate above a level of 4 inches from the top.

- Garbage may not be transferred from can to can, as spillage may result in the attraction and breeding of flies.

- Cans must be cleaned thoroughly after emptying and prior to returning to stands

(2) Garbage bags. Some food service establishments, depending on local authority, use disposable plastic-lined paper bags for the collection and disposal of garbage. Such a method, where authorized locally, eliminates much of the labor connected with cleaning garbage cans.

g. **Rubbish**. Rubbish consists of solid waste other than food and food products. Rubbish is normally placed for collection in truck-portable refuse containers (dumpsters) or in galvanized iron containers like those used for garbage. The same rules of cleanliness, which apply to garbage containers, govern rubbish containers.

h. **Insect arid Rodent Control**

(1) Insect- and rodent-borne diseases. Insects and rodents are responsible for the spread of many serious infectious diseases, including malaria, yellow fever, encephalitis, filariasis, typhus, tularemia, plague, leptospirosis, rabies, and many others.

- Of primary concern to food service facilities, however, are those diseases that are transmitted by a combination of pests and foods.
- Many of the diseases discussed in this lesson may be spread by insects or rodents which come in contact with filth from latrines, garbage, or any outside source, and then contaminate food.

- The most common offenders are the housefly, the cockroach, the rat, and the mouse.

(2) Physical measures. The most effective control measure against insects and rodents is to prevent entry.

- When inspecting, give special attention to screens, to the closeness of fit of doors and windows, and to the effectiveness of door-closing devices.

- Insects may be detected by their presence and by checking dark or closed areas with a flashlight.

- The presence of rodents is normally indicated by droppings in and around storage areas and by gnawing on the exterior of cartons and sacks.

(3) Extermination. Methods of insect and rodent control are discussed in lesson 6.

i. **Food Service Inspections**. The only way that a commander can be assured of a satisfactory state of food service sanitation within his command is through the use of periodic inspections.

- The Surgeon General of the Army is responsible for establishing sanitary standards for the design, construction, operation, and maintenance of food service facilities.

- The responsibility for proper enforcement of these standards, however, is a command responsibility.

(1) Unit commanders. Unit commanders having food service activities within their units are responsible for conducting periodic inspections of their dining facilities to ensure that established sanitary standards are maintained.

- These inspections are command inspections, as opposed to technical inspections. They may be conducted by the dining facility manager, the dining officer, or the commanding officer himself. Normally they will be conducted by all three of these individuals at different times.

- The frequency of inspections depends upon the manner in which the food service personnel respond to corrections and recommendations.
- It is incumbent upon every commander, and every young officer assigned the duties of dining officer, to familiarize himself with the appropriate regulations and manuals governing food service sanitation.

- Few individuals, no matter how competent, can commit to memory all of the things which must be checked in conducting a food service inspection.

- Therefore, each unit should prepare an inspection guide to ensure that inspections will be complete, uniform, and impartial.

- Such a food service inspection guide may be found in the appendix to this subcourse. Appropriate references are included. To include the provisions of these references in the inspection guide itself would make the length prohibitive for practical purposes. The references are not necessary for this subcourse.

(2) Installation commanders

- The commander of an installation exercises his responsibility for food service sanitation through his director of medical activities and the preventive medicine activity.

-- Each health and environment activity has assigned health and environment technicians who are technically qualified to conduct food service sanitary inspections.

-- During field operations, this responsibility shifts to the preventive medicine section of the division medical battalion headquarters company, for divisional units; or the supporting preventive medicine field service unit, or team, for non-divisional units.

- Food service inspections by preventive medicine personnel are of two types: announced and unannounced.

-- The announced inspection is a scheduled inspection conducted at regular intervals. Both the unit commander and the dining facility manager are notified prior to the inspection.

-- The unannounced inspection is conducted on an irregular basis so that the dining facility will be observed in its normal mode of operation.

-- The dining facility manager is not given advance notification.

-- However, as a matter of normal military courtesy, the inspecting individual reports to the unit headquarters or orderly room and notifies the unit commander before proceeding to the dining facility for the inspection.

- Inspections are usually conducted between 1000 and 1400 hours and include the serving of the noon meal.

-- The inspector is accompanied by the dining facility manager

-- Emphasis is on proper temperature control, proper food storage, cleanliness, and proper food handling techniques.

-- On-the-spot corrections are encouraged.

-- The results of the inspection are discussed immediately with the dining facility manager.

-- Normally, a report of the inspection is left with the dining facility manager, one is given to the unit commander, and one is forwarded through the director of medical activities to the installation commander, depending on local policy.

-- The inspector rates the facility satisfactory or unsatisfactory. Inspection checklists are locally devised.

- If the inspection is to accomplish its purpose of detecting and correcting any unsanitary practices, the personnel must be receptive to the inspector.

-- The inspector establish satisfactory “rapport” with the personnel of the facility being inspected.

-- Such rapport can be established only by exercising courtesy, respect, and consideration toward those being inspected.

2-15. MEASURES APPLICABLE TO THE SUSCEPTIBLE PERSON

Susceptibility to food- and water-borne diseases is general.

a. **Vaccines**. Vaccines of limited value exist for typhoid and paratyphoid fevers and for cholera.

- These vaccines are used as supplements to, not substitutes for, personal hygiene and general sanitation.

- No perfect vaccines exist for any of the other diseases discussed in this section.

b. **Educate Personnel**. Accordingly, all personnel must be instructed in the causes, sources, modes of transmission, ways of preventing or controlling transmission of intestinal and parasitic diseases. Personal hygiene must become a fixed habit.

c. **Personal Hygiene**. All personnel should learn and practice the principles of personal hygiene, to avoid contracting and spreading of disease.

- Particularly important measures applicable to the susceptible person are:

  -- Hand washing
  -- Sanitary disposal of body waste
  -- Sanitation of personal equipment
  -- Avoidance of known sources of disease
  -- Prompt reporting of disease symptoms.

Continue with Exercises

EXERCISES, LESSON 2

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Select the correct responses. The so-called “food poisoning” may actually be:

   a. Bacterial infections
   b. Bacterial intoxications
   c. Viral infections
   d. Viral intoxications
   e. Chemical intoxications

2. a. Almost 80 percent of reported gastroenteritis outbreaks in the United States are caused by individuals ingesting food contaminated by certain strains of _____.

   b. List three types of foods which chiefly cause staphylococcal food poisoning:

   - _____
   - _____
   - _____

3. The prevention of bacterial intoxications and bacterial infections in foods is based upon _____ and _____.

4. Typhoid fever is normally contracted by consuming food or water contaminated with _____.

5. A schistosome is a/an:

   a. Liver fluke
   b. Blood fluke
   c. Intestinal fluke
   d. Lung fluke

6. In combat, troops may be unable to avoid cercariae-infested water. In that case, troops should be told the preventive measures to take because cercariae results in the parasitic disease _____.

7. Thorough cooking of pork is important in the prevention of _____.

8. List two ways food poisoning is different from other food-borne diseases.

   a. _____

   b. _____

9. Eating improperly cooked beef or pork may result in a _____ infestation.

10. Why is it unwise to store lemonade in a zinc-galvanized garbage can?

11. Fluke infestations (other than schistosomes) are acquired by eating insufficiently cooked _____ or _____.

12. One of the most effective sanitary measures in preventing food-borne diseases is _____.

13. When humans eat infected crabmeat, the young worms (in the life cycle of the fluke) hatch in man's _____, then migrate to _____.

14. Perishable foods should be kept at temperatures below ___° F or above ____° F.

15. Food handlers should be examined by a physician before returning to duty after an absence of more than ____ days.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 2

1. a,b,e (para 2-3d, e, f)

2. a. Staphylococci (para 2-3e)
   b.
   - Meats (particularly cured ham)
   - Pastries containing custard or cream fillings
   - Puddings (para 2-3e)

3. Sanitation and temperature control (paras 2-13c, d; 2-14b(1))

4. Feces (para 2-4c)

5. b (para 2-11a)

6. Schistosomiasis (para 2-11c(2))

7. Trichinosis (para 2-8f)

8. a. Relatively abrupt onset
   b. Violent symptoms (para 2-3)

9. Tapeworm (para 2-9b(1); 2-9b(7))

10. Lemonade is acid. The acid ionizes the zinc metal. The result is zinc ions in the lemonade, which causes acute heavy metal poisoning. (para 2-3d)

11. Fish or crab (para 2-10e)

12. Thorough hand washing (para 2-13d)

13. Intestine
    Various organs of man's body
    (para 2-10b)

14. 45, 140 (para 2-14b(1))

15. 30 (para 2-13d)

End of Lesson 2

LESSON ASSIGNMENT

LESSON 3	Respiratory Diseases
LESSON ASSIGNMENT	Paragraphs 3-1 through 3-20
LESSON OBJECTIVES	After completing this lesson, you should be able to:

3-1 Identify the principal infectious agents causing respiratory diseases.

3-2 Identify the factors that are important in the epidemiology of particular respiratory diseases.

3-3 Identify appropriate measures for the prevention and control of respiratory diseases of military importance.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 3

RESPIRATORY DISEASES

Section I. EPIDEMIOLOGY OF RESPIRATORY DISEASES

3-1. GENERAL

Causative agents for respiratory diseases of military importance include certain viruses, bacteria, fungi, and rickettsiae. On the basis of symptoms and mode of transmission, the respiratory diseases may be classified into three categories: respiratory tract symptoms/ transmission by discharges from nose and mouth; transmission from infectious materials from the air; transmission by discharges from nose and throat with symptoms not localized in the respiratory tract.

a. **Diseases with Symptoms Localized in the Respiratory Tract.** For some diseases, the symptoms are localized in the respiratory tract, and the diseases are transmitted by discharges from the nose and mouth. Such diseases include the common cold, diphtheria, influenza, bacterial pneumonia, streptococcal sore throat, tuberculosis, and others.

b. **Diseases Transmitted Through Inhalation of Infectious Material from the Air.** These are diseases transmitted through inhalation of infectious material from the air but not necessarily coming from discharges of the respiratory tract. Included are smallpox, coccidioidomycosis, Q fever, and others.

c. **Transmission by Discharges from Nose and Throat/Symptoms not localized in the Respiratory Tract**. These are diseases spread by discharges from the nose and throat but symptoms of which are not localized in the respiratory tract. Included are measles, mumps, meningococcal meningitis, scarlet fever, and, again, smallpox.

3-2. FACTORS IN TRANSMISSION: GENERAL FACTORS

Respiratory disease agents carried in respiratory discharges apparently are transmitted by one of two means: droplets and droplet nuclei.

a. **Droplet Transmission**

(1) Distance droplets travel. In the normal course of respiration, a person exhales droplets of moisture that are on the order of 50 microns in size. These droplets usually travel about 4 to 5 feet horizontally from their point of release in air before rapidly falling out because of their weight. If forcibly expelled, as in sneezing or coughing, they may travel much farther.

(2) What droplets carry. Droplets easily carry a multitude of disease agents from the respiratory tract of the infected person.

- Droplet or direct contact transmission is effected when the susceptible person comes in close association or direct contact with the infected person, his exhalations, or with personal articles, clothing, bedding, or similar fomites moistened by respiratory discharges from the infected person.

- Members of a family or members of a military unit housed in the same tent or bay are easily subject to such contact. These contacts are sometimes called familial contacts.

b. **Droplet Nuclei.** Droplet nuclei are the residue of dried-out respiratory discharge droplets. Approximately 1 to 5 microns in size (although some may be smaller), they consist of infectious agents plus organic matter remaining after the saliva and moisture originally in the droplet have evaporated.

(1) Travels of droplet nuclei. These nuclei do not fall rapidly but remain in the air for long periods of time and travel with the air currents. Those that settle out on floors, clothing, bedding, or other fomites can be resuspended in the air as dust on any movement such as shaking, dusting, or sweeping.

(2) Transmission of droplet nuclei. When disease agents in the droplet nuclei are drawn into the respiratory tract of a susceptible, there is disease agent transmission without direct contact with the disease source. Respiratory disease transmission of the type mentioned in paragraph 3-1b includes droplet nuclei transmission, in that the disease agents may be suspended in the air and inhaled by the susceptible.

3-3. FACTORS IN TRANSMISSION: MILITARY FACTORS

a. **Crowding**. In the military, the population tends to be crowded.

(1) The situation

- As members of a military unit, people are housed, fed, drilled, and trained as a group.

- They march together and go into combat together.

- In-group activities---crowding in washrooms, eating in dining halls, and waiting in line for various activities--opportunities are increased for direct contact between military personnel.

(2) The result. The transmission of respiratory disease agents is aided by these conditions of crowding and increased direct or indirect contact.

- Various studies of barracks and wards have shown that the bacterial and viral populations in the air are directly proportional to the number of people in the area and to the degree of their activity.

- Thus, in inhabited areas, when the dust content of the air is high, the level of bacterial and viral contamination of the air is likewise high.

b. **Susceptibility in Recruits**. Epidemiological experience in the military has shown that there is a much higher susceptibility to the respiratory infections in recruits as compared to the veterans or "seasoned" soldiers. Evidence shows that the incidence of respiratory disease decreases as the length in the military service increases.

c. **Lowered Resistance in Recruits**. Some investigators consider the new environment found by the recruit when first entering the service to be an important psychological factor in lowered resistance.

(1) Reasons for lowered resistance

- He is homesick and away from his established routine of habits.

- He becomes exposed to strange and unfamiliar surroundings, and the emotional stress is particularly high.

- The fatigue and physical exhaustion found in the early training program might be an important aspect.

(2) The result. All these may lower the recruit's resistance to respiratory infections. This is particularly true for the common respiratory diseases. One theory is that the causative virus agents may remain in a latent state in the nasopharynx and become active in periods of lowered resistance.

LOWERED RESISTANCE IN RECRUITS

- Homesick.
- Away from routine of habits
- Unfamiliar surroundings
- High stress level
- Fatigued/physically exhausted in early training

3-4. MILITARY IMPORTANCE OF RESPIRATORY DISEASES

The common respiratory diseases are the greatest single cause of admission of Armed Forces personnel to medical facilities. They have accounted for more time lost from duty than any other single cause, excluding injuries.

a. **History.** During World War II, 29,000 people on the average were absent from duty each day because of respiratory diseases.

- There was a total loss from duty of 42,000,000 man-days during that war because of these diseases (1942-1945).

- Approximately 5 million American soldiers required hospitalization for common respiratory disease during that period.

b. **Significance of Statistics**. These statistics, monumental as they are, do not represent the total incidence of infection during these periods, because many cases of respiratory disease manifest only minor symptoms, and they are not reported to dispensaries. These cases, nevertheless, can serve as sources of serious outbreaks.

3-5. COMMON RESPIRATORY DISEASES: GENERAL

The common acute respiratory diseases alone are responsible for more noneffectiveness than any other group of communicable diseases.

- Although these diseases occur in all military populations, certain specific disease agents, such as the adenoviruses, are responsible for most epidemics in recruit (nonseasoned) populations.

- Acute respiratory disease may be manifested in a variety of clinical syndromes, from the common cold to pneumonia, and may be caused by an even larger number of disease agents.

- There are at least 28 stereotypes of adenovirus that affect humans. They are differentiated only by laboratory tests.

- The term acute respiratory disease (ARD) in recruits is used frequently in reference to the grippe-like syndrome in recruits caused by adenoviruses.

3-6. COMMON RESPIRATORY DISEASES: THE COMMON COLD

Probably the most frequently occurring disease of this group, the common cold, is presumed to be caused by a virus, probably by more than one type.

a. **Transmission**. Transmission is by direct contact, droplets, or freshly contaminated fomites. Many investigators feel that the virus is constantly present in a

latent or dormant state in the nasopharynx and can become reactivated when the host's body resistance, to it, is low. This would account for the development of the familiar cold symptoms that accompany or follow fatigue, chilling, or emotional stress.

b. **Signs/Symptoms**. The common cold is a mild disease. The usual complaints are running nose and eyes, sore throat, and malaise lasting from 2 to 7 days. Fever is uncommon.

c. **Importance of the Disease**. The disease is important both for causing lost time and for predisposing the patient to more serious infections.

d. **Immunity.** While limited, temporary immunity probably exists against the specific virus that caused a particular case. Temporary immunity does not prevent prompt development of a second case.

e. **Treatment.** Treatment includes bed rest and aspirin as needed for headache.

- Antibiotics should not be used, but should be reserved for treatment of severe complications.

- The patient should practice self-isolation, personal hygiene, and sickroom sanitation to break the chain of infection.

3-7. COMMON RESPIRATORY DISEASES: PRIMARY ATYPICAL PNEUMONIA (PAP)

Primary atypical pneumonia is a term adopted during World War II to describe those cases of 'nonbacterial" pneumonia for which no etiology could be found.

a. **Classical Case**. World War II nonbacterial pneumonia was:

- Unresponsive to sulfa and penicillin therapy

- Appeared as a patchy, ill defined, mottled infiltrate in one or both lower lobes of the lungs

- Associated with fever, cough, and malaise

b. **In Military Personnel**. This type of pneumonia accounts for at least 80 percent of pneumonia in military personnel.

- Studies in military recruits have shown that about 10 percent of these cases are because of adenoviruses, 50 percent to *Mycoplasma pneumoniae* (Eaton agent), and 40 percent to unknown agents.

- *Mycoplasma* is a genus of bacteria that resembles viruses and causes virus-like illnesses.

c. **Treatment**. Since tetracycline therapy for 5 to 10 days will shorten the clinical course of *Mycoplasma pneumoniae,* proper etiologic diagnosis is useful, especially if large numbers of cases are occurring.

- An oral adenovirus vaccine has been developed and has been found effective in reducing respiratory infections in recruits by 40 to 50 percent.

3-8. COMMON RESPIRATORY DISEASES: INFLUENZA

A given episode of influenza is caused by one of the multiple types of influenza viruses.

a. **Effect of Variety of Viruses**. Since there is such a wide-variety of influenza viruses and so little cross-immunity between them, periods of freedom from disease often are relatively short.

CLASSIFICATION BY CLINICAL SYNDROME		
TERM	INCLUDES	SOME CAUSES
Common cold	Nasopharyngitis Coryza	Rhinovirus Influenza Parainfluenza Respiratory syncytial virus
Pharyngitis Tonsillitis	Follicular tonsillitis Exudative pharyngitis	Strep Adenovirus Influenza *Coxsackie A* Parainfluenza
Acute upper respiratory	Fever Chills Headache Malaise Sore throat	Adenovirus Influenza Parainfluenza
Acute lower respiratory diseases	Bronchitis Bronchiolitis Pneumonia	Adenovirus (50-80 percent in recruits) Mycoplasma pneumoniae (10-50 percent in recruits) Influenza Parainfluenza Bacteria

CLASSIFICATION BY ETIOLOGIC AGENT		
TERM	INCLUDES	SOME CAUSES
Virus	Adenovirus	80 percent of all acute respiratory diseases in recruits
	Myxovirus Influenza Parainfluenza	
	Picornavirus Coxsackie	
	Rhinovirus–30 types	
	Reovirus	
Mycoplasma pneumoniae		
Bacteria	*Stretpococcus* spp. Others	

Table 3-1. Classification of acute respiratory diseases

- An entire unit or community can develop influenza within 24 to 72 hours after exposure to a newly introduced virus to which the members are susceptible.

- This point is starkly illustrated by the pandemics of 1889, 1918, and 1957-1958.

-- In 1918, more than 20 million people died from influenza caused by the so-called swine virus or one closely related to it.

-- The 1957-1958 pandemic of Asian influenza was much milder but was pandemic in the full sense.

b. **Influenza Today**. Influenza now is an acute self-limiting disease of abrupt onset, lasting from 1 to 6 days.

- Recovery in otherwise healthy persons of military age may follow in from 5 to 7 days.

- Death from influenza itself, or from pneumonia as a complication, sometimes occurs in persons who are weakened or debilitated.

c. **Transmission.** Transmission is by:

- Direct contact with an infected person, fomites freshly contaminated with infectious respiratory discharges

- Possibly by droplet nuclei

d. **Signs/Symptoms**. Fever, chills, body aches, and malaise or prostration is usual, with upper respiratory symptoms less prominent and appearing later

e. **Diagnosis.** Diagnosis is confirmed by finding the virus in throat washings and sera of patients and convalescents.

f. **Treatmen**t. There is no specific treatment. To minimize secondary infection, bed rest, preferably in isolation, is essential. Return to duty should be delayed until recovery is complete and chance of secondary infection is significantly reduced. In the military setting, this may involve up to 30 days absence from duty.

g. **Prevention**. Good patient hygiene and sickroom sanitation should be maintained. Prevention of influenza is difficult for four reasons:

- The incubation period is short.

- Prevalent strains of viruses tend to be replaced by others having different biologic properties.

- There is a large variety of these viruses.

- The disease occurs in cycles; consequently, the vaccines that have been developed usually must be changed each year based on responsible forecasts of the agent or agents likely to be active in the forthcoming season.

3-9. VIRUS DISEASES PRESENTING NON-RESPIRATORY SYMPTOMS: MUMPS

a. **In Military Personnel.** Outbreaks of mumps are both frequent and serious in-groups of young persons of military age.

- In the United States Army during World War II, more than 100,000 cases of mumps were diagnosed.

- About 30 percent of these were complicated by orchitis (inflammation of the testes), which may be accompanied by psychological stress.

b. **Signs/Symptoms**. Characteristically in mumps, fever is accompanied by swelling and tenderness of one or more of the salivary glands.

- In young adults, involvement of the pancreas and/or ovaries or testes is a complication.

- Among military personnel, this complication greatly increases the amount of time away from the work site.

c. **Prevention**. Fortunately, there is a vaccine for mumps for those who are not already immune.

d. **Transmission.** The virus for mumps is spread:

- By droplets

- By direct contact with an infected person

- With fomites freshly contaminated with infectious saliva

e. **Incubation Period**. The incubation period for mumps is from 12 to 26 days. The infected person can transmit the disease 7 days before and for 9 days after onset of symptoms.

f. **Treatment/Immunity**. There is no specific treatment. Isolation of the patient for this latter period helps confine the disease, but other measures are essentially useless. Generally, lasting immunity is conferred.

3-10. BACTERIAL INFECTIONS: MENINGOCOCCAL MENINGITIS

a. **In Military Personnel**. The military importance of this disease lies in its high death rate (8-25 percent) and its panic-producing effect on populations. The causative agent, *Neisseria meningitides,* is transmitted by respiratory discharges. The disease is primarily one of recruits.

- One striking feature in the epidemiology is the high carrier rate among basic trainees--as high as 80 percent by the 7th week of training.

- Initially, at the beginning of basic training, about 20% of trainees carry the organisms in their throats

- By the end of training, all recruits have been carriers at some time.

b. **Signs/Symptoms**. Meningococcal meningitis is a febrile disease having an acute onset with chills, headache, and malaise.

- The disease is often preceded by symptoms resembling an upper respiratory infection.

-- Petechiae (small pinpoint hemorrhages in the skin and mucous membranes) can be found early (before clinical meningitis is apparent).

-- Usually, they are found early in the armpits and about wrists and ankles.

-- Later in the disease, they may cover the entire body.

- Any recruit with fever, upper respiratory symptoms, and petechiae should be suspected of having a meningococcal infection until proved otherwise.

-- Take appropriate laboratory specimens (culture of blood, petechiae).

-- Take spinal fluid; perform spinal fluid examination.

-- Initiate specific treatment.

c. **New Strains**. In the United States, peak years of meningitis occur about every 10 years. In military populations, cases occur during times of mobilization or crowding.

- Before 1950, most epidemics, including military, were because of closely related strains of *N. meningitides.*

- Beginning in the spring of 1963, new strains became more prominent as causative agents did.

- This was important because the new strains were found to be sulfa resistant.

- During, 1964, over 100 cases of meningococcal meningitis occurred at Fort Ord, California.

- Prophylaxis was of no avail because of the predominance of the sulfa resistant strains.

d. **Prevention/Control Measures**. Prevention and control of meningococcal meningitis consists of all measures aimed at:

- Reducing the spread of the organism

- Reducing stresses and fatigue in recruits

Because these measures will not eliminate the problem, <u>early diagnosis</u> through a high index of suspicion and careful examination is paramount in preventing death.

Meningococcal vaccine is administered to all basic trainees on a year-round basis.

3-11. BACTERIAL INFECTION: STREPTOCOCCAL INFECTIONS

a. **In Military Personnel**. Pathogenic streptococci cause infections, which present various clinical symptoms.

- Chief among those of military importance is streptococcal sore throat, or, if symptoms include rash, scarlet fever.

- In World War II an estimated 150,000 cases of streptococcal sore throat were hospitalized, including about 26,000 cases of scarlet fever.

b. **Transmission.** These infections are transmitted by direct contact with the infected person, contaminated fomites, droplets, and probably droplet nuclei.

c. **Symptoms/Diagnosis.** Physical symptoms (except for the rash, if present) are confined to the throat. For diagnosis, throat cultures should be made of all patients with sore throats.

d. **Prognosis**. In the United States, the fatality rate is low and the disease itself is less severe than in other areas, where from 3 to 5 percent of the cases terminate fatally.

- Ear infections, tonsillitis, and other complications may accompany or follow the acute infection.

- A carrier state may persist for months in certain untreated cases.

- After 1 to 4 weeks, rheumatic fever, kidney infections, or other complications may follow.

- Rheumatic fever follows about 3 percent of the untreated cases of streptococcal disease.

  -- The estimated cost to the United States Government of each case of rheumatic fever in the military is from $37,000 to $50,000.

- Kidney infections may follow 10 percent or more of the cases, depending on the particular strain of streptococcus responsible for the infection.

e. **Prevention.** Prevention of streptococcal infections and their complications depends chiefly on:

- Prompt reporting of minor respiratory symptoms to the dispensary.

- Early diagnosis, followed by prompt and adequate treatment of streptococcal infection

- Education of personnel in the importance of the practice of good personal hygiene and environmental sanitation

- Administration of prophylactic dosages of penicillin to persons at special risk as conditions warrant.

3-12. BACTERIAL INFECTIONS: DIPHTHERIA

Although diphtheria is not now common in the United States because of a widespread immunization program, it is highly endemic in many areas of the world. Diphtheria is caused by the bacteria *C. diphtheriae.*

a. **In the Military**. Because the disease exists in many countries, it is of potential military importance.

- Clinical disease is seen most often in temperate zones during autumn and winter, but infection rates in the tropics are comparable.

- During World War II, approximately 5,700 cases among US Army personnel were reported, 125 terminating fatally.

b. **Symptoms/Fatalities**. Most of the general symptoms and fatalities of this acute febrile infection are caused by the toxin produced by *Corynebacterium diphtheriae.* The local lesion produced in the clinical form is typified by a grayish membrane or patches on the pharynx, soft palate, and tonsils. The toxins enter the bloodstream and may affect the heart, brain, kidneys, or other organs.

c. **Transmission**. Transmission is by contact with a case or carrier, with discharges from the respiratory tract or skin lesions; with contaminated fomites; or by consumption of milk containing *C. diphtheriae.*

d. **Diagnosis**. Clinical diagnosis is sufficient basis for immediate isolation and specific treatment of cases at bed rest, without waiting for confirmation by bacteriological examination.

e. **Specific Treatment**. Specific treatment is prompt administration of diphtheria antitoxin.

f. **Prevention**. Prevention relies chiefly on mass immunization plus search for carriers, atypical cases, and contaminated milk during an outbreak.

-- ATTENTION --

DO NOT routinely administer antibiotics on the assumption that streptococci cause most sore throats.

3-13. BACTERIAL INFECTIONS: TUBERCULOSIS

Tuberculosis is a chronic disease of variable course that is present in nearly every community, including the military community as a whole. It is an important cause of death in most parts of the world.

a. **In Military History**. In the US Army during World War II, tuberculosis incidence rates were approximately one per 1,000.

b. **Transmission**. The disease is transmitted by droplets, droplet nuclei, direct contact with an infectious person, and by ingesting milk from infected cows. Tuberculosis is caused by *Mycobacterium tuberculosis,* the tubercle bacillus.

c. **Signs/Symptoms**. The primary or initial infection is likely to go unnoticed. Tubercular lesions of the lungs develop and heal without treatment. The infected person is infective during periods when lesions are open and discharging bacilli, but noninfective when all lesions are healed over in remission. The respiratory discharges and sputum of many infected persons remain intermittently for years.

d. **Treatment.** Although most primary lesions heal without treatment, prompt therapy of active cases with anti-tubercular drugs is indicated, provided the patient can tolerate the regimen and drug-fastness does not develop.

e. **Control Measures**

- "Open" tuberculosis cases should be hospital isolated, initially at bed rest, until lesions heal and the patient has learned the hygienic essentials of tuberculosis control.

- Periodic x-ray examination of the lungs and tuberculin test surveys of the general population (and more frequently for those at special risk, such as Army Medical Department personnel,) uncover recent primary infections.

- All personnel entering the U.S. Army is skin tested initially. Negative reactors should be skin tested annually.

- Positive reactors who do not receive antibiotic prophylaxis should have annual chest x-rays.

3-14. OTHER RESPIRATORY DISEASES

a. **Coccidioidomycosis**. This highly infectious disease is endemic to the arid and semi-arid areas of the Southwestern United States, particularly the San Joaquin Valley of California, and areas of similar climate in Argentina, Mexico, and Russia. Coccidioidomycosis is a fungus infection of the respiratory tract.

(1) Transmission/diagnosis. Coccidioidomycosis is transmitted by inhalation dust laden with the spores of the fungus, *Coccidioidosis immitis.* Confirmation of the diagnosis includes finding *C. immitis* in the sputum.

(2) Control measures. Dust control measures on installations include paving or oiling roads and runways and planting grass. Such measures may be of value in preventing the transmission of disease.

b. **Q Fever**. Q fever is an acute disease, which may become chronic. It is caused by *Coxiella burnetii (Rickettsia burnetii)* and distributed worldwide, including endemic areas of the United States.

(1) Cause/transmission. This disease is unique, in that it is caused by a rickettsia transmitted by respiratory means rather than by an arthropod vector.

(2) Signs/symptoms. Characteristically there is:

- Sudden onset of chills
- Headache
- Sweating
- General weakness
- Usually pneumonia
- Attendant fever similar to primary atypical pneumonia (PAP)

(3) Reservoir/transmission. *C. burnetii* survives well and may be transmitted by several means. Cattle, sheep, and goats are natural reservoirs important in the transmission of the disease to man. The animals, as well as their milk and afterbirth, contaminate barnyard soil, straw, railroad cars, with *C. burnetii* organisms that are later inhaled with dust by man.

(4) In military personnel. Outbreaks in military personnel have occurred among troops occupying barns, houses, railroad cars, or ships previously housing animals.

- A classic example was an outbreak in Italy during World War II when 269 cases from an infantry battalion were hospitalized in a 3-week period.

- All 900 members of this unit had attended compulsory training films shown in the loft of a barn, which was partially filled with old dirty hay.

(5) Transmission/prevention. Transmission directly from man to man is negligible. For control and prevention, follow these guidelines:

- Observe good sickroom hygiene.
- Disinfect contaminated fomites.
- Generally, prevent the disease in animals (by vaccination and other means) and avoid infected animals and their habitants.

c. **Respiratory Transmission of Certain Arthropod-Borne Diseases**. Under conditions, several diseases, which are classed as arthropod-borne diseases, may also be transmitted by respiratory means.

- In epidemic typhus outbreaks, a few cases may be caused by inhalation of dried infective louse feces in dust.
- In endemic typhus outbreaks, an occasional case may be caused by inhalation of dust containing dried infective flea feces.
- In a case of plague, in which the causative agent has migrated to the patient's lungs (pneumonic plague), the disease is highly communicable by respiratory discharges.

Section II. TROOP HOUSING AND RESPIRATORY DISEASE CONTROL

3-15. GENERAL

a. **The Problem**. The factors in transmission of respiratory diseases make outbreaks of these illnesses more difficult to control than other types of diseases. This is particularly true in the military, where close contact with large numbers of people is a way of life.

b. **Control Measures**. Control measures for respiratory diseases in military units are based primarily on maintaining high standards in troop housing, where most close contact occurs. The following factors should be emphasized:

REDUCE RESPIRATORY DISEASES IN MILITARY UNITS

- Avoid overcrowding
- Maintain proper ventilation, temperature, and humidity.
- Control dust.
- Make maximum use of sunlight.
- Immunize, where applicable.
- Practice proper oral hygiene.

3-16. OVERCROWDING

The one factor most closely associated with the incidence of respiratory disease is overcrowding. Accordingly, every effort is made to prevent or to minimize overcrowding in troop billets.

a. **Relationship Between Overcrowding and Respiratory Disease**. Over the years, the Army has conducted various studies to correlate the incidence of respiratory diseases with various billeting factors, including floor space per man, length of association between members of units, and distances between beds. Although the data are old, the basic principles still apply. The studies indicate that:

- The incidence of influenza decreased as the amount of floor space per soldier increased.

- When considering recruits, even with more floor space per soldier, the incidence of respiratory disease was high.

NOTE: The conclusion was that recruits are more susceptible to respiratory infections than “seasoned” troops.

b. **Minimum Floor space Requirements**. Army regulations prescribe minimum sleeping area requirements for troop billets. Sleeping area is defined as an area that includes beds, footlockers, wall lockers, and personal articles. Excluded are stairs, halls, latrines, utility rooms, recreation areas, storage rooms, and other administrative areas.

(1) Minimum sleeping area for recruits. In view of the increased vulnerability of recruits to respiratory diseases, Army regulations prescribe a minimum sleeping area of 72 square feet per basic trainee in training centers, both in peacetime and under emergency conditions.

(2) Sleeping area for ‘seasoned” troops. Troops, other than trainees, may be billeted in less than 72 square feet of sleeping area.

- An effort must be made to provide at least 72 square feet of floor space per individual.
- When this standard cannot be achieved, the minimum sleeping area per individual should not be less than 55 square feet.

(3) Sleeping area during emergencies and temporary peak billeting periods. During emergencies and temporary peak billeting load periods, troops (other than trainees) may be billeted at 40 square feet per soldier. However, commanders authorizing this reduced floor space must recognize and be prepared to accept the increased noneffectiveness from greater incidence of respiratory disease.

c. **Cubicalization**

(1) The Army practice. The Army has long practiced the head-to-foot placement of beds to maximize the distance between the heads of personnel sleeping in barracks.

- The practice of "double decking" will further increase this distance and aid in preventing the transmission of respiratory diseases.

(2) The individual cubicle system. In cases where crowding cannot be avoided and/or respiratory diseases are present, the individual cubicle system may be employed to minimize the transmission of disease agents through droplets and droplet nuclei.

- Bed cubicles are made by converting each bed space into its own compartment with the use of improvised screens.

- A common method is to attach a pole to the leg at the head of each bed, extending approximately one foot above the head.

- A shelter half, blanket, or sheet is then attached to the top of the pole and the foot of the bed, with the lower portion tucked under the mattress.

- This procedure establishes a physical barrier to the direct movement of exhaled droplets from one individual to another.

d. **Miscellaneous**. Overcrowding should also be avoided in classrooms, day rooms, and so forth, especially in periods of respiratory disease epidemics.

- This may best be accomplished by using alternate seating arrangements.

- In addition, maximum use of the outdoors for training is encouraged

3-17. VENTILATION, TEMPERATURE, AND HUMIDITY

The gentle circulation of fresh air at all times, and especially during periods of greatest personnel activity, aids in limiting dust and bacterial contamination in the air. Extremes of humidity and temperature are undesirable. It is suggested that, where possible, the temperature be near 68° F during daylight and 66-68° F at night.

-- OPTIMUM CONDITIONS --

Relative humidity of 45 to 60 percent at the suggested temperature is comfortable.

Proper humidity, comfortable temperature, sunlight, and good ventilation reduces the hazard of contact infection**.**

a. **Ventilation.** Ventilation can be provided by either mechanical or natural means.

- Air conditioning equipment for troop housing is not always available.
- Circulating fans, exhaust fans, and blowers, however, are readily procured.
- In many instances, these mechanical devices can satisfy the needs adequately.
- For proper ventilation, 600 to 900 cubic feet of air per soldier per hour should be moving at a velocity of 45 to 50 feet per minute.
- Ordinary windows, if properly adjusted in troop barracks, will normally meet this requirement.

b. **Air Circulation**. Natural circulation occurs when warm air, being lighter than cool air, rises.

- Natural circulation is best obtained by admitting cool, fresh air near the floor and allowing it to escape near the ceiling after the air has become warmed in the room and thus rises.
- It is generally desirable that the inlets and outlets of air should be on opposite sides of the room, since this permits better mixing of fresh air with the stale air in the room.

- If properly opened, windows serve the purpose very well.

-- The windows on the windward side should be opened at least 6 inches from the bottom, allowing cool air to enter.

-- Windows on the opposite or leeward side should be opened at least 6 inches from the top, allowing the warm air to escape.

- The rate of air change will vary with the wind velocity, outside temperature, and activity within the billet.

-- It may be regulated by the amount of open window space.

-- For practical purposes, it is better to open several windows slightly than one widely.

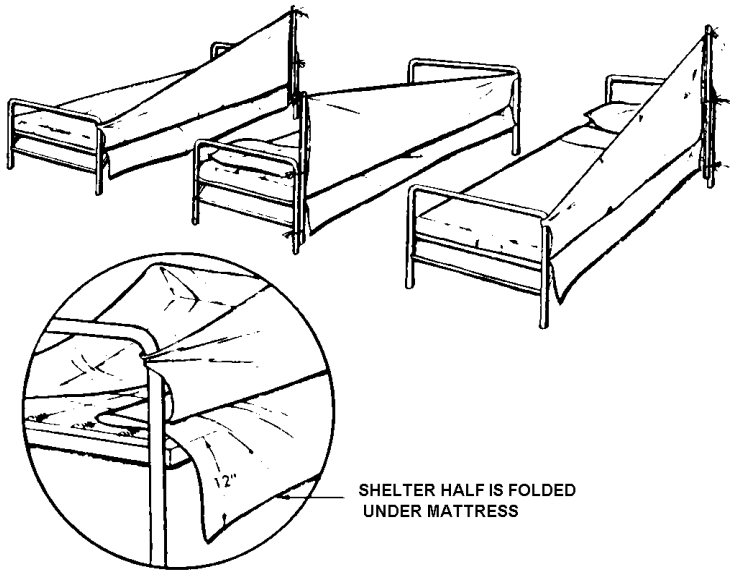


Figure 3-1. Construction of cubicles
(Note also head-to-foot arrangement of adjacent beds.)

c. **Ventilation and Activity in a Room**. It should be noted that the degree of activity in a room is an important consideration for determining the amount of ventilation required for good health. The greater the activity, the more ventilation needed. For example, more ventilation is needed during the day than at night.

(1) Ventilation During Cold Weather at Night. During extremely cold weather at night, the heating system may provide adequate ventilation without opening windows. If the windows are opened, the result may be a loss of heat and thus a lowering of the resistance to infection of the soldiers housed within. Just the simple common cold may put the entire billet population on the sick list.

(2) Over ventilation. Discretion is needed under adverse conditions of this nature. No amount of over ventilation can compensate for overcrowding; over ventilation may cause chilling and do more harm than good.

3-18. DUST CONTROL

Dust control is very important in fighting respiratory diseases.

a. **Infectious Organisms in Dust**. The principle in providing ample sleeping space in barracks is to allow exhaled droplets and droplet nuclei containing infectious organisms to fall to the floor, rather than be inhaled by another individual

- This principle will be defeated if dust on the floor is stirred up as to re-contaminate the air.

- Some organisms, especially the tuberculosis bacilli, continue to live for some time after falling to the floor or other surface.

b. **Floor Maintenance**. Therefore, dry sweeping should not be permitted. Dry sweeping raise dust, which may be germ-laden.

- Either a sweeping compound or soap and water should be used.

- Oil or light paraffin may also be used to settle the dust on floors.

-- It has been found that oiling of barracks floors reduces airborne bacteria by approximately 70 percent.

-- In hospital studies, it has been observed that oiling the floors will reduce the bacteria count by 90 percent.

-- A special oil emulsion has been developed for the treatment of bedding during the laundering process.

-- This compound does not impart a greasy or oily feel to the material, nor does it constitute a fire hazard.

3-19. SUNLIGHT

Respiratory diseases are effectively reduced by the practice of airing and sunning barracks, bedding, and blankets.

a. **Natural Solar Radiation**. Natural solar radiation as a sterilizer of air has long been known and accepted as a valuable disease control measure. Bacterial counts in the air are reduced by exposure to sunlight and even diffuse daylight.

b. **Bedding**. Weather permitting, pillows and mattresses, with the mattress covers removed, should be aired outdoors weekly.

-- Blankets should be shaken out at least twice each week when the weather permits and exchanged as often as is necessary to maintain cleanliness.

-- Sheets and pillowcases should be changed at least weekly.

3-20. SPECIAL MEASURES APPLICABLE TO RECRUITS

Because of the known susceptibility of newly inducted recruits to respiratory diseases, special procedures have been established to prevent the occurrence of these illnesses to the maximum possible extent. These procedures were initiated specifically to prevent the recurrence of the meningitis epidemic, which occurred at the U.S. Army Training Center at Fort Ord, California, in 1964; however, the measures are applicable in the prevention of all respiratory diseases. In addition to the minimum sleeping space requirements discussed in paragraph 3-16b(1) (72 square feet per individual), the following measures are prescribed:

a. **Unit Integrity**. Where possible, new recruits are assigned to self-contained units at the reception center, and they remain in those units throughout the entire 8-week basic training cycle.

- Platoon sized units are preferable, the size of the platoon being based upon the troop housing utilized.

- During all processing, training, housing, dining, and recreational activities, maximum effort is directed toward maintaining platoon integrity and minimizing contacts between platoons.

- The ideal situation would be to isolate units and thus limit exposures to respiratory disease agents to those already present in the unit.

b. **Cycle Breaks**

- "Back-to-back" training cycles, i.e., assigning newly processed trainees to barracks just vacated by soldiers completing their training, should be discouraged.

- Whenever possible, a break of one or two weeks should be established between successive training cycles, to permit maintenance and airing of individual barracks.

c. **Rest**. Schedules, including mandatory lights out, reveille formations, and compensatory time for night exercises or duty, should be arranged to ensure a minimum of 8 hours sleep or rest.

d. **Physical Training**

- Physical training and exertion should be geared to the capabilities of the individual to prevent unnecessary fatigue.

- Extra periods of physical exercise as a disciplinary measure are not recommended.

e. **Personal Hygiene.** Supervisory personnel should constantly instruct trainees in the principles of good personal hygiene, with particular emphasis on the following:

INSTRUCT TRAINEES in PRINCIPLES of GOOD PERSONAL HYGIENE

- Proper use of clothing and equipment to avoid overheating, and particularly, chilling.
- Covering the mouth when coughing and sneezing.
- Avoidance of spitting, except in sanitary receptacles.
- Frequent cleansing of mouth and teeth.

f. **Surveillance**

(1) "Buddy system" to detect disease. An extension of the "buddy system," which is used to prevent cold injuries (para 5-4c) and to detect attached ticks in some training areas, may be useful in detecting early signs of respiratory disease---particularly meningitis.

- Buddies are responsible for getting each other to report to sick call at the earliest symptom of respiratory infection.

- This aids in preventing the highly motivated trainee from endangering his health-or-life by not reporting for early diagnosis and treatment.

(2) Admission policy for hospitals/dispensaries

- In addition, hospitals and dispensaries providing health care to training centers should follow a very liberal admissions policy.

- Over-hospitalization is far better than running the risk of overlooking the symptoms of a severe respiratory infection such as meningitis.

Continue with Exercises

EXERCISES, LESSON 3

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Tuberculosis and influenza are examples of diseases whose symptoms are localized in the respiratory tract, diseases that are transmitted by _____.

2. Recruits are (more)(less) susceptible to respiratory infections than the “seasoned’ soldier.

3. The groups of diseases responsible for more noneffectiveness than any other group of communicable diseases are the _____.

4. Pneumonia caused by Mycoplasma pneumoniae or various viruses is known as _____.

5. Influenza is caused by a _____.

6. The most frequently occurring respiratory disease is _____.

7. Measles, mumps, and scarlet fever are examples of diseases transmitted by _____with symptoms not localized_____.

8. a. In normal respiration, moisture drops exhaled by an individual travel _____ feet horizontally through the air before falling because of their weight.

   b. If the moisture droplets are forcibly exhaled by a_____or a _____, they may travel much farther.

9. What disease has particular military importance not only because of its high death rate, but also because it strikes a disproportionately large number of recruits?

   _____

10. Streptococcal infections are usually localized in the _____.

11. In the spaces below, enter the letter D if the descriptive phrase applies to diphtheria, T if it applies to tuberculosis and B if it applies to both:

    a. _____ Of bacterial origin
    b. _____ An acute, febrile infection
    c. _____ Uncommon in the U.S.
    d. _____ May be transmitted in milk from infected cows
    e. _____ A chronic disease which may go unnoticed for long periods
    f. _____ Symptoms caused primarily by bacterial toxin

12. _____ is a fungus infection of the respiratory tract that occurs in arid and semi-arid regions.

13. _____ is an exception to the usual rickettsiae diseases, in that it is transmitted by respiratory means rather than by an arthropod vector.

14. Name three arthropod-borne diseases that may be spread by respiratory means:

    a. _____

    b. _____

    c. _____

15. List three ways of reducing the incidence of respiratory diseases in a unit?

    a. _____

    b. _____

    c. _____

16. _____ control is as important as cleanliness in preventing respiratory diseases.

17. Frequent sunning and airing of _____ helps to prevent the spread of respiratory diseases.

18. a The minimum amounts of floor space per basic trainee in training centers (in peacetime or under emergency conditions) is _____ square feet per soldier.

    b. During emergencies and peak billeting periods, troops other than trainees may be allotted _____ square feet per soldier.

    c. Commanders who authorize the floor space listed in b must accept increased troop non-effectiveness from _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 3

1. Discharges from the nose and mouth (para 3-1a)

2. More (para 3-3b)

3. Common acute respiratory diseases (para 3-5)

4. Primary atypical pneumonia (para 3-7b)

5. Virus (para 3-8)

6. The common cold (para 3-6)

7. Discharges from nose and throat. In the respiratory tract (para 3-1c)

8. a. 4 to 5
   b. Cough; sneeze (para 3-2a(1))

9. Meningococcal meningitis (para 3-10a)

10. Throat (para 3-11c)

11. a. B
    b. D
    c. D
    d. T
    e. T
    f. D (paras 3-12; 3-12b; 3-13; 3-13b; 3-13c)

12. Coccidioidomycosis (para 3-14a)

13. Q fever (para 3-14b(1))

14. a Plague
    b Epidemic typhus
    c Endemic typhus (para 3-14c)

15. You are correct if you listed any three of the following:

    a. Avoid overcrowding
    b. Maintain proper ventilation, temperature, and humidity
    c. Control dust
    e. Make maximum use of sunlight
    f. Immunize, where applicable
    g. Practice proper oral hygiene (para 3-15b)

16. Dust (para 3-18)

17. Barracks, bedding, and blankets (para 3-19)

18. The minimum amounts of floor space per basic trainee in training centers (peacetime or under emergency conditions) per soldier are:

    a. 72 (para 3-16b(1))
    b. 40 (para 3-16b(3))
    c. Greater incidence of respiratory diseases (para 3-16b(3))

End of Lesson 3

LESSON ASSIGNMENT

LESSON 4	Injuries Due to Environmental Extremes
LESSON ASSIGNMENT	Paragraphs 4-1 through 4-29
LESSON OBJECTIVES	After completing this lesson, you should be able to:

4-1 Identify the clinical signs and symptoms of cold and heat injuries and select the appropriate first aid measures for each.

4-2 Identify the environmental and host factors, which are likely to result in heat or cold injury.

4-3 Use the WBGT index or the wind chill factor to predict the risk of heat or cold injury on a given day.

4-4 Identify the important elements of an effective program for the prevention of heat and cold injuries.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 4

INJURIES DUE TO ENVIRONMENTAL EXTREMES

Section I. ENVIRONMENTAL COLD INJURIES

4-1. INTRODUCTION

a. **Definition-Cold Injury.** Cold injury is defined as tissue trauma produced by exposure to cold. The type of injury produced depends upon the degree of cold to which the body (or its parts) is exposed, the duration of exposure, and certain environmental factors.

(1) Chilblain. Chilblain is a swelling and reddening of the skin that usually results from intermittent exposure to temperatures above freezing accompanied by high humidity. Although chilblain itself is not a dangerous cold injury, it can result in open sores (lesions), which can become infected and can lead to more dangerous cold injuries.

(2) Immersion syndrome. Trench foot and immersion foot, result from prolonged exposure to wet, cold footgear or outright immersion of the feet at temperatures usually below 50° F.

- There is no major difference between trench foot and immersion foot with respect to management or to the conditions that cause the injury.

- Both result from prolonged exposure of the feet to wet cold:

  -- Trench foot to cold, wet socks and boots.

  -- Immersion foot to cold water.

- Both occur with or without socks and boots.

- The term "immersion syndrome" is often employed to cover immersion foot, trench foot, and similar cold injuries.

- At the upper range of temperatures, exposure of 12 hours or more will cause injury.

- Shorter durations at or near 32° F will cause the same injury.

- Immersion syndrome is usually associated with standing in place for significant amount of time.

(3) Frostbite. Frostbite results from exposure to temperatures below the freezing point (below 32° F).

- The depth and severity of the injury is a function of the temperature and the duration of exposure--the lower the temperature, the shorter the time required to produce injury.

- At very low temperatures, freezing of exposed skin can occur within a few seconds.

(4) Generalized hypothermia. Generalized hypothermia occurs when the entire body, not just a part, cools to an abnormal level (below 95° F).

-- ATTENTION --

Generalized hypothermia is a medical emergency. A soldier who is in excellent condition can die in a matter of minutes from severe hypothermia.

As the body cools:

- The blood circulation in the limbs is impaired.

- The pulse becomes weak, shock develops, unconsciousness occurs.

- Eventually the heart ceases to beat.

Being immersed in cold water for a period, such as being thrown into cold-ocean water after a shipwreck, is one cause of generalized hypothermia.

b. **The Impact of Cold Injury on the Military.** Cold injury occurs among the civilian population, but its primary impact is on the military forces. Cold injury has been recorded as a problem of military importance since the days of Xenophon and Alexander of Macedonia.

- The US Army had considerable experience with cold injury during World War II.

-- There were a total of 90,535 time-lost injuries including trench foot and frostbite in ground troops and high-altitude frostbite in aircrews.

- During the Korean conflict, United States troops in Korea experienced more than 9,000 cases of cold injury, chiefly frostbite in ground troops.

-- Over 8,000 of these cases occurred in the winter of 1950-1951.

4-2. FACTORS INFLUENCING THE INCIDENCE OF COLD INJURIES

Cold injury, as it involves a military population, follows accepted epidemiologic principles. A specific agent is present and a variety of environmental and host factors influence the incidence, prevalence, type, and severity of the injury. These factors combine in the total causation of cold injury, but the influence of each may vary in different situations. Careful evaluation of these factors and their relative effects serves to guide preventive and control activities.

a. **The Agent.** Cold is the specific agent in cold injury and is the immediate cause of tissue damage. If, however, the effect of cold is considered the loss of body heat, a relationship between heat conduction and heat production is seen and the ways in which various host and environmental factors modify cold injury become clearer. Therefore, the effect of cold cannot be evaluated by ambient (air) temperature alone.

b. **Weather.** Weather is a predominant influence in causing cold injury. Factors that modify the rate of body heat loss are:

- Temperature
- Humidity
- Precipitation
- Wind velocity

Low (freezing) temperatures favor frostbite whereas higher temperatures, together with ground moisture, are usually associated with other cold injuries. Wind accelerates the loss of body heat under both wet and dry conditions. The cooling effect of the wind (wind chill) is discussed in paragraph 4-3.

c. **Type of Combat Action.** The incidence of cold injury varies greatly according to type of combat action.

- Units in reserve or in rest areas have few cases.

- When units have holding missions or they are on static defense, exposure is greater, and a moderate increase in incidence is expected.

- When units are on active defense or offense, a marked increase in cold injuries usually occurs.

- Factors, which contribute to increasing the risk of cold injury, include:

  -- Immobility under fire.
  -- Prolonged exposure to the weather.
  -- Lack of opportunity to re-warm and change clothing or carry out personal hygiene measures.

-- Fatigue.
-- Poor nutrition.

d. **Clothing.** In warfare, where exposure to cold may be prolonged, adequate and properly worn clothing is essential to welfare and survival.

- Clothing for cold weather combat has been designed to be worn as an assembly for protection of the head, torso, and extremities.

- Failure to wear the total assembly and inadequate supplies of proper sizes of clothing are important factors in cold injury.

- The assembly depends upon the layering principal to conserve body heat.

--Loose layers of clothing with air space between them and worn under an outer wind and water-resistant garment provide maximum protection.

--Some of the layers may be removed during strenuous physical exertion, for comfort, and minimize perspiration in higher ambient temperatures.

- Clothing made wet by perspiration loses much of its insulating value; therefore, care must be taken to prevent perspiration from accumulating in clothing.

- In all forms of cold injury, conservation of body heat is important. All articles of clothing should be worn loosely, without constriction or tightness.

- Clothing should be kept free of grease and dirt since grease and dirt promote heat loss.

e. **Duration of Exposure.**

(1) Immersion syndrome /trench foot. The duration of exposure needed to cause immersion syndrome varies according to the ambient (air) temperature and the temperature of the water. The average duration of exposure resulting in trench foot is three days at a temperature range of 32° to 50° F. The time needed to cause trench foot usually ranges from a few hours to 14 days.

(2) Frostbite. The average duration of exposure resulting in frostbite is 10 hours, with a usual range of 1 to 20 hours. The time varies for different types of activity. A decrease in physical activity reduces the exposure time necessary to produce cold injury. For patrols and other offensive maneuvers, for example, the period of greatest susceptibility usually begins at that time when walking ceases either because of arrival at an ambush site or because of being pinned down by the enemy.

(3) Fatality. Immersion of the torso and extremities in water below 50° F, as in northern latitudes, may result in death in less than one hour due to excessive lowering of body temperature (hypothermia).

f. **Previous Cold Injury.** A previous episode of cold injury definitely increases the individual's risk of subsequent cold injury and not necessarily involving the part previously injured. However, minor degrees of superficial cold injury, when completely healed, probably do not predispose to subsequent injury sufficiently to require profiling or other restriction on assignments.

g. **Fatigue.** Fatigue contributes to cold injury. Mental weariness may cause apathy leading to neglect of acts vital to survival. This occurs more frequently in personnel who have been in combat for 30 days or more without rest.

- Frequent rotation of troops from active combat duty for even short periods lessens the influence of the fatigue factor.

h. **Activity.** Too great or too little activity may contribute to cold injury.

- Over activity can cause the loss of large amounts of body heat by perspiration. The perspiration can become trapped in excess clothing and markedly reduce the insulating quality of the clothing.

- Conversely, immobility causes decreased heat production by the body with the danger of resultant cooling, especially in the extremities of the body (fingers, toes, etc.). In general, though, a decrease in physical activity decreases the exposure time needed for cold injuries to occur.

i. **Nutrition.** Lack of food intake or poor nutrition predisposes to cold injury. The normal military ration of 3600 to 4600 calories provides adequate nutrition.

j. **Use of Alcohol.** Alcohol affects the blood circulatory system and causes an increase in loss of body heat. The dangers of excessive lowering of body temperature (hypothermia) and frostbite are increased greatly under its influence. Alcohol can also result in carelessness and failure to take adequate protective measures. The use of alcoholic beverages should be avoided when working in cold environments.

k. **Medication.** Physicians should advise patients of any adverse effects on peripheral circulation or sweating when prescribing drugs and medications in cold climates.

l. **Concomitant Injury.** Experience has shown that injuries resulting in significant blood loss or shock reduce effective blood flow to extremities and predispose to cold injury.

m. **Discipline, Training, and Experience.** Proper use of simple preventive measures, which are inspected and enforced by officers and noncommissioned officers markedly, reduces the incidence of cold injury.

- Individual and unit discipline, training, and experience are closely related in their influence upon the incidence of cold injury.

- Well-trained and disciplined soldiers usually suffer less than others from the cold because they are more likely to:

  -- Care for themselves through personal hygiene.

  -- Care for their feet.

  -- Change clothing.

  -- Exercise the extremities when immobilized.

  -- Take similar preventive measures.

Soldiers from warm climates may need additional training and supervision.

4-3. THE WIND CHILL CHART

a. **Wind** + **Temperature and Body Heat.** The human body is continually producing and losing heat. Wind promotes the loss of heat by removing the thin layer of warm air next to the skin. The rate of heat loss increases as the wind speed increases. When the temperature of the air is below freezing and the wind removes the heat faster than the body can replace it, frostbite may occur. Thus, either a decrease in the ambient (air) temperature or an increase in the wind speed acts to increase the danger of frostbite to unprotected (exposed) skin, especially the face and ears. The combined effect of wind and temperature is expressed in the wind chill chart (Table 4-1) as an equivalent temperature. This chart expresses the combined effect of temperature and wind upon exposed flesh as though it was an ambient temperature with no air movement.

Estimated wind speed (in mph)	Actual Thermometer Reading (° F.)											
	50	40	30	20	10	0	—10	—20	—30	—40	—50	—60
	EQUIVALENT TEMPERATURE (° F.)											
calm	50	40	30	20	10	0	—10	—20	—30	—40	—50	—60
5	48	37	27	16	6	—5	—15	—26	—36	—47	—57	—68
10	40	28	16	4	—9	—24	—33	—46	—58	—70	—83	—95
15	36	22	9	—5	—18	—32	—45	—58	—72	—85	—99	—112
20	32	18	4	—10	—25	—39	—53	—67	—82	—96	—110	—124
25	30	16	0	—15	—29	—44	—59	—74	—88	—104	—118	—133
30	28	13	—2	—18	—33	—48	—63	—79	—94	—109	—125	—140
35	27	11	—4	—21	—35	—51	—67	—82	—98	—113	—129	—145
40	26	10	—6	—21	—37	—53	—69	—85	—100	—116	—132	—148
(wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER (for properly clothed person) Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh			GREAT DANGER				
	Trench foot and immersion foot may occur at any point on this chart.											

Table 4-1. Wind chill chart.

b. **Movement of Air Over the Body.** Any movement of air past the body has the same cooling effect as wind. Air movement may be produced by walking, running, skiing, or riding in an open vehicle. The speed of movement must be considered in addition to natural wind when using the wind chill chart.

c. **Clothing as a Protection,** It is emphasized that this chart is of value in predicting frostbite only to exposed flesh. Any clothing or material, which stops or reduces the wind, will give a degree of protection to the covered area. No attempt should be made, however, to estimate this protection when using the wind chill chart. Wet clothing or boots have a much-reduced insulating value and will result in heat loss nearly equal to that of exposed flesh.

d. **Using the Wind Chill Chart.** To use the chart, find the wind speed in the left-hand column and the actual temperature in degrees Fahrenheit in the top row. The equivalent temperature is found where these two intersect. The description below the columns indicates the comparative danger of frostbite to exposed flesh under these conditions. For example, an actual temperature of 23° F with a 20-mph wind is equivalent in cooling power to a temperature of -6° F (6 degrees below zero) with no wind. Interpolate for figures between those shown.

e. **What the Wind Chill Chart Shows.** The wind chill chart shows the cooling power of wind on exposed flesh, giving the equivalent rate of cooling as compared to what would be experienced under calm conditions at the lower temperature. No matter how great the wind velocity, however, exposed flesh will not freeze so long as the ambient temperature remains above freezing. Other cold injuries, though, can occur at temperatures much higher than those shown on the chart.

4-4. PREVENTION OF COLD INJURIES

Cold injuries are preventable. Successful prevention requires vigorous command leadership and proper use of preventive measures, which are inspected and enforced.

- Of major importance are:

  -- Prior planning.
  -- Cold weather training.
  -- The provision of proper clothing and equipment.

- Specific preventive measures should be directed toward:

  -- Conservation of total body heat.
  -- Avoiding unnecessary prolonged exposure of personnel to cold, moisture, and activities favoring cold injury.

a. **Meteorological Data.** All commanders should be familiar with the utilization of simple weather data such as humidity, temperature, wind, and ground surface conditions, which influence the risk of cold injury.

- Some weather conditions will require shortening of the exposure time of individuals engaged in patrol, guard, or motor movements in unheated vehicles.

- These weather conditions can frequently be anticipated by using weather data to predict the hazard for the next 12-hour period.

- Thus, clothing may be provided for anticipated weather conditions and the periods of exposure shortened, if indicated.

b. **Cold Injury Control Officer.** Each platoon or comparable-sized unit should have a cold injury control officer or noncommissioned officer. This person should be carefully selected on the basis of leadership, interest, and ability to supervise others in simple but constant preventive activities. Frequent observation of the soldiers for early signs and symptoms of cold injury is of the utmost importance.

- He should check the soldiers daily for good personal hygiene---especially good foot care. A change of socks at appropriate intervals, along with reasonable efforts to keep feet clean and dry, is essential.

- He should likewise encourage efforts to perform warming exercises, especially during periods of immobility.

- He should also ensure that soldiers DO NOT wear their clothing and footgear so tight as to constrict blood circulation.

c. **The Buddy System.** Members of squads and patrols should be taught to observe their companions for evidence of cold injury.

(1) Immediate care. If sudden blanching of the skin is noted promptly, immediate care will usually prevent the development of a more serious cold injury.

- Holding (not rubbing) a warm hand on the blanched area of an ear, nose, or cheek until a normal color has been restored provides adequate rewarming.

- The part must then be protected against further exposure to cold. Fingers can be warmed against the skin of the abdomen or the armpit.

- Toes can be rewarmed by holding them against a companion's chest or abdomen under his outer clothing.

(2) Signs/symptoms. A reliable symptom of early frostbite of fingers and toes is the sudden loss of the sensation of cold or discomfort in the part. This is often

followed by a pleasant feeling of warmth. If these danger signals are instantly heeded, cold injury can be prevented.

d. **Clothing.** A standard number of layers of clothing cannot be prescribed for universal wear throughout winter. Flexibility must be provided for local conditions. Certain basic principles are important, including:

- Ventilation of the body during physical activity
- Cleanliness and repair of clothing to prevent loss of insulation
- Avoidance of constriction produced by snug fitting socks, boots, underwear, sweaters, jackets, and trousers.

Commanders must ensure their troops have proper clothing and the clothing is worn properly.

(1) Work clothing. When working, remove excess layers of clothing before perspiration starts so that clothing does not become wet. Avoid wetting clothing or footgear since moisture causes a dramatic loss of insulating quality.

(2) How to wear clothing and boots. Wear clothing and footgear loose enough to trap air between layers (the trapped air provides good insulation) and to permit good circulation of blood to all parts of the body. Avoid tight-fitting uniforms.

(3) Protecting hands and wrists. Keep hands well protected; mittens are more protective than gloves. Glove or mitten inserts that become wet should be removed and dried or exchanged for dry inserts as quickly as possible. Avoid lengthy exposure of bare hands and wrists to conditions that will cause stiffening and reduce circulation; it takes a long time to recondition the hands to normal use. Do not touch metal, snow, or other cold objects with bare hands. Do not spill gasoline on skin or clothing.

(4) Excess clothing. Remove excess clothing when in a warm enclosure or in front of a fire to avoid sweating.

(5) Footgear. In all types of footgear, feet perspire more than other parts of the body. Moisture accumulates in socks and decreases their insulating quality. Special foot and sock care is essential in cold weather.

- Extra socks should be carried by all personnel
- Socks damp from perspiration will dry if carried unfolded inside the shirt.

- Socks should be changed at least daily and washed whenever the opportunity permits.

- Socks and other clothing soiled with dirt, grease, or salt from perspiration will conduct heat more rapidly, thus affording less protection against the cold.

(6) The insulated rubber combat boot. Ground forces personnel in cold areas are equipped with the insulated rubber combat boot.

- Frequent change of socks is important with this boot because the increased sweating and retention of sweat can lead to trench foot.

- Although sweating in this boot does not contribute to the loss of insulation, it nevertheless leads to the softening of the soles of the feet by the retained sweat.

- Damage to tissues, produced by walking, results in a loss of skin from the soles of the feet which may require hospitalization.

- Cold injury to feet can result even when wearing insulated boots.

- These injuries usually result from inactivity and dependency of the foot, as occurs with prolonged sitting or standing without frequent foot or leg movement.

4-5. SIGNS AND SYMPTOMS OF FROSTBITE

The general lack of warning symptoms emphasizes the insidious nature of cold injury, which unfortunately is overlooked by many troops and commanders.

- The warning symptoms of frostbite may only be a tingling, stinging, or dull aching sensation of the exposed part followed by numbness.

- The skin may briefly appear red and then become pale or waxy white.

- If freezing has occurred, the affected part may feel “like a block of wood.”

4-6. TREATMENT OF COLD INJURIES

Treatment of cold injury depends upon the time elapsed after injury, the severity of the injury, the presence of complications, and the area affected.

a. **Treatment in Military Operations.** In military operations, treatment is influenced by the tactical situation, as well as by the facilities available for the evacuation of casualties.

- Most cold injuries appear en masse during periods of intense combat and at the time that large numbers of other casualties occur.

- The examination and treatment of life-endangering wounds must take precedence over cold injuries.

- Highly individualized treatment is difficult during military operations because of the large numbers of casualties who require treatment almost simultaneously.

b. **Treatment for Types of Cold Injuries.** The treatment of cold injury is divided into first aid, emergency medical treatment in forward areas, and definitive treatment after the patient has reached a hospital. Since the latter two stages of treatment are conducted only by qualified medical personnel, we shall discuss only first aid at this point. If possible, prevent further exposure to cold or at least shelter the casualty from wind.

c. **Chilblain.** Treatment for chilblain consists mainly of re-warming the affected body part and preventing infection if open sores are present.

(1) Re-warm the body part.

- Re-warm an affected ear, nose, or facial area by covering the areas with a hand until the part is warm again. Usually, the casualty can perform this re-warming himself.

- Re-warm affected areas on the hands (usually fingertips) by opening the casualty's field jacket, having the casualty put his hands under his armpits (right hand under left armpit, etc.), and closing his clothing so as to prevent additional loss of body heat.

- Re-warm toes and other affected areas on the casualty's feet by removing his boots and socks, placing his feet against the abdomen of another person (either you or a fellow soldier), and covering the casualty's feet with clothing. The person warming the casualty's feet must take measures to ensure that he does not develop cold injuries himself.

(2) Protect lesions. If skin lesions (open sores) have developed, cover the lesions with a dry sterile dressing. Do not apply any ointment to the lesion since the moisture in the ointment may cause additional cold injury.

(3) Seek medical help. Chilblain usually does not require evacuation since there will be little or no loss of skin tissue. The casualty should be seen by medical personnel, though, when the opportunity presents itself.

d. **Immersion Syndrome.** The treatment outlined below should be begun as soon as possible for immersion syndrome.

(1) Dry affected area. Dry the affected area immediately.

(2) Rewarm affected area. Re-warm the affected part gradually by exposing it to warm air. If warm air from a heated source is not available, the affected area is normally re-warmed using the same procedures as with chilblain. Covering the affected part of the limb with dry, loose clothing or with several layers of warm coverings is also an acceptable method of re-warming.

-- CAUTION --

- DO NOT massage the skin of the affected area.
- DO NOT apply extreme heat to the affected area
- DO NOT apply cold (ice or snow) to the affected area.

(3) Elevate affected area. Elevate the affected part using a stable prop. Elevating the part will help to reduce swelling in the affected part.

(4) Protect affected area. Protect the affected limb from being accidentally hit and from falling from its elevation support. Open sores should be covered with a dry, sterile dressing.

(5) Evacuate. The casualty should be evacuated to a medical treatment facility for additional medical treatment as soon as possible. Move the casualty by litter or manual carries. Do not let him walk if walking can be prevented.

e. **Frostbite.** A person with frostbite should be moved to the most sheltered area available. Perform the procedures given below. Do not give alcoholic beverages or tobacco to the casualty.

(1) Rewarm the frostbitten area. Re-warm the affected area using the same procedures given in paragraphs 4-6a and b. DO **NOT** rub or massage the frostbitten area, soak the area, or apply cold or extreme heat to the area.

-- WARNING --

- Rewarm the casualty's frostbitten feet only if the casualty will not need to walk any further to receive medical treatment. (The casualty may be evacuated by air, and so forth.)

- Thawing a casualty's feet and then forcing him to walk on them will cause additional pain and injury.

(2) Evacuate. The casualty should be evacuated to a medical treatment facility as soon as possible. Do not allow a casualty with frostbitten feet to walk if he can be evacuated by titter or by manual carry.

f. **Hypothermia.**

(1) Stop heat loss. Prevent the casualty from losing any more body heat by moving him out of the wind. If his clothing is wet, remove the wet clothing and replace them with dry clothes, blankets, or sleeping bag.

(2) Provide external heat source. The ability of the casualty's body to produce heat faster than it loses heat has probably been lost. Therefore, you cannot expect that covering the casualty with blankets and other material will result in the body being re-warmed. You must supply another source of heat so that the casualty's body can absorb the heat. The body must be re-warmed quickly, but not so rapidly as to cause arrhythmia (irregular heart beat).

- The best re-warming technique is to immerse the casualty's torso in a tub of warm (105° F to 110° F) water, taking care that the casualty's legs and arms are not immersed. Keeping the limbs from re-warming as fast as the trunk when immersion is used will decrease the likelihood that the casualty will go into shock.

- Hot water bottles placed around the casualty's body, electric blankets, and a campfire are some other methods of producing heat.

- You can also use the heat from your body or from another soldier's body to re-warm the casualty. Remove your outer clothing, lie next to the casualty, and cover the two of you with blankets or other materials. The coverings will hold in your body heat and allow the casualty to absorb the heat that your body is giving off.

(3) Provide warm drink. If the casualty is conscious, give him something warm and nutritious to drink. Sugar or glucose tablets may be added to sweeten drinks. (The heat from the drink can be absorbed by the body and the sugar can be used by the body in producing heat.)

-- CAUTION --

- DO NOT give the casualty any alcoholic beverages to drink.
- Alcohol causes capillaries to dilate, allowing the body to lose heat faster.

(4) Administer rescue breathing, if needed. Hypothermia may cause the casualty to stop breathing. You may be able to save his life by administering rescue breathing immediately.

(5) Evacuate. Evacuate the casualty to a medical treatment facility as soon as possible. Handle the casualty gently.

Section II. ENVIRONMENTAL HEAT INJURIES

4-7. INTRODUCTION

a. **Command Responsibility.** Prevention of heat injury is a command responsibility and function.

b. **The Staff Surgeon's Responsibility.** The staff surgeon is responsible for recommending the initiation of measures to safeguard health and for supervising the execution of these measures.

c. **The Result of Failure to Take Preventive Measures.** Failure to take proper preventive measures can result in heavy loss of manpower.

Example. A battalion arrived at Qui Nhon, Vietnam, after 18 days aboard a ship.

- The men were brought into an area of inadequate water and shade, and they began work as if at their home station.

- In the first 72 hours, approximately 100 men were treated for heat prostration or heatstroke.

- The situation was especially bad because medical supplies had not been unloaded.

Knowledge and proper planning would have prevented these casualties.

4-8. ENVIRONMENTAL FACTORS AFFECTING HEAT LOSS

The environmental conditions to which troops must adapt can vary greatly. Troops participating in maneuvers near the Soviet border may encounter the extremes of the Arctic cold. On the other hand, troops participating in maneuvers in the Middle East must adapt to the extremes of equatorial heat. Exposure to high environmental temperature produces stress on the body, which may lead to illness and disability. Let's look at the factors that can impact negatively on the soldier exposed to heat stress.

a. **Environmental Conditions Affecting Body Heat and the Body's Adjustments to Heat.** The conditions in the environment which influence the heat of the body and its adjustments are:

- Temperature of the air.
- Temperature of the surrounding objects.
- Vapor pressure of the water in the air (relative humidity).
- Air movement.
- Type and amount of clothing worn.

b. **Ways the Body Gains and Loses Heat.** Three ways in which the body gains and looses heat are conduction, radiation, and evaporation.

c. **Heat Loss by Conduction.** Heat loss by conduction to the air occurs when the air temperature is below body temperature. Conversely, heat gain by conduction occurs when air temperature exceeds that of the body.

d. **Heat Loss by Radiation.** Similarly, the body loses heat by radiation when the surrounding objects have surface temperatures lower than the temperature of the body surface and gains heat by radiation when the temperature of surrounding surfaces is above that of the body surface.

e. **Heat Loss by Combinations of Air and Surrounding Objects.** Accordingly, temperature combinations of the air and the surrounding objects may exist which result in heat gain by the body because of radiation, even if the air temperature is below that of the body.

f. **Body Responses.** The enlargement of blood vessels in the skin and an increase in the rate of the heartbeat are normal body responses to heat stress. While these adjustments increase the temperature of the skin and thus increase heat loss by conduction and radiation, they place a strain on the circulatory system. These factors play important roles in the -cause of heat stress reactions.

g. **Heat Loss Through Sweating**. When the body cannot lose sufficient heat by conduction and radiation, the activity of the sweat glands increases and heat loss by evaporation of sweat becomes the important means of maintaining normal body temperature. As the relative humidity of the air increases, however, evaporation of sweat decreases, thus reducing the cooling function of the sweat. Excess sweating may lead to a marked loss of water and salt from the body. The resulting dehydration and loss of body salt add to the stress on the circulatory system.

4-9. OTHER FACTORS AFFECTING HEAT LOSS

Other major factors influencing the likelihood of heat injury include the physical work - being performed and the physical condition of the individual.

a. **Body Heat and Physical Work.** The body is continually producing heat, but during physical work the production of heat is increased in proportion to the type, intensity, and duration of the work. Thus, physical work accentuates the effects of high temperature.

b. **Body Heat and Physical Condition.** Individual susceptibility to heat stress may be increased by a variety of conditions including:

- Acute and chronic infections.
- Febrile conditions.
- Reactions to immunizations.
- Conditions affecting sweat secretion.
- Heat rash or acute sunburn.
- Previous occurrence of heatstroke.
- Use of alcohol.
- Dehydration.
- Lack of sleep.
- Fatigue.
- Obesity.

NOTE: The risk of heat injury is much higher in overweight persons than in those of normal weight. Special care should be exercised when such persons are exposed to high temperatures.

4-10. TYPES OF HEAT INJURY

Although humans live in various regions with marked variations in the environmental heat, the temperature of the human body is regulated within extremely narrow limits.

a. **Three Types.** Three distinct types of heat injury may occur when the body cannot deal adequately with the heat. The type of heat injury incurred depends upon the manner of breakdown of the individual's heat adjustment. These injuries are heat cramps, heat exhaustion, and heatstroke.

b. **Recognition/Knowledge of First Aid--A Responsibility of All Military Personnel.** The three conditions that produce distinctive signs and symptoms should be recognized at once--not only by AMEDD personnel, but also by unit personnel--if the casualty is to receive proper care and attention. All military personnel in the field should be familiar with the first aid treatment of these conditions.

4-11. HEAT CRAMPS

Heat cramps are primarily caused by the loss of salt in the form of perspiration. Usually, heat cramps are promptly relieved by rest and by replacing some of the salt and water lost through perspiration.

a. **Signs and Symptoms.** Painful cramps of the muscles may occur following exposure to heat.

- The muscles of the extremities and of the abdominal wall are usually involved and the cramps may be of great severity.

- Body temperature is normal.

- The casualty may be perspiring heavily and be very thirsty.

b. **Treatment.**

(1) Protect casualty from sun. Move the casualty to a cool, shaded area to rest. If shade is not available, improvise using ponchos, blankets, or other available materials to protect the casualty from direct sunlight. Have the casualty sit or lie in a comfortable position.

(2) Loosen clothing. Loosen the casualty's tight-fitting clothing if you are not in a chemical environment.

(3) Give water and salt solution. Give the casualty a water and salt solution to help restore his body's natural (fluid and salt) balance.

- Dissolve 1/4 teaspoon of loose salt (same as one packet of salt from rations) in a canteen (one quart) filled with cool water.

- Have the casualty drink the entire canteen within a one-hour period.

-- If no salt is available, still have the casualty drink at least one quart of cool water.

-- If the casualty is still thirsty after drinking the salt solution, allow him to drink cool, unsalted water.

NOTE: If the casualty feels nauseous (feels as though he is going to vomit), encourage him to drink cool water (no salt added).

Vomiting caused by drinking salty water will only result in the loss of more water and salt from his body.

When the feeling of nausea has passed, give him the salt and water solution to drink or salty food to eat.

(4) Evacuate, if needed. If the casualty continues to have severe cramps, evacuate him to a medical treatment facility.

4-12. HEAT EXHAUSTION

Heat exhaustion results primarily from excessive loss of water from the body without adequate fluid replacement. This dehydration results in decreased blood volume. Salt depletion is often present also. The mortality rate from this disorder is extremely low. The removal of the casualty usually to a cool environment, rest, and the *administration of* water will result in prompt recovery.

a. **Signs and Symptoms.** Heat exhaustion is characterized by:

- Weakness.
- Dizziness.
- Faintness (especially on standing).
- Headache.
- Heavy sweating.
- Loss of appetite.
- Nausea and muscle cramps may also be present.
- Skin--cool, pale, clammy.
- Pulse rate--rapid (140-200 per minute).
- Blood pressured may be lowered.

NOTE: The patient rarely loses consciousness.

b. **Treatment.**

(1) Protect casualty from sun. Move the casualty to a shaded area or construct shade for the casualty.

(2) Loosen clothing. Loosen or remove tight-fitting clothing and boots if you are not in a chemical environment.

(3) Cool casualty. If the day is very hot, pour water on the casualty and fan the casualty. This will help the casualty's body to lose heat.

(4) Give salt and water solution. Have the casualty drink at least one quart (one canteen) of the salt solution described in paragraph 4-11 b (3). If salt is not readily available, have the casualty to drink at least one quart of cool water. Encourage the *casualty to* drink the water slowly and steadily. This will decrease the likelihood of vomiting.

(5) Elevate legs. Have the casualty lie down on his back and place a pack, small log, rolled-up field jacket, or other stable prop under his feet. If a litter is available, have the casualty lie on the litter and elevate the foot of the litter. This procedure will help blood to return from the casualty's legs to his heart and will help to prevent shock.

(6) Evacuate, if needed. If the casualty is unable to drink water because of nausea or if the casualty's signs and symptoms do not improved after drinking fluids, medical attention is required. Evacuate the casualty to a medical treatment facility.

4-13. HEATSTROKE (SUNSTROKE)

In the condition heatstroke, the casualty's temperature-regulating mechanisms fail, and his body cannot get rid of excessive heat. **Heatstroke is a medical emergency.** Heatstroke can occur to:

- Individuals who work or exercise in hot environments--athletes, laborers, and the military.

- Elderly people who live in poorly ventilated apartments without air conditioning.

- Children left in cars with the windows rolled up.

a. **Signs and Symptoms.** Included are the following:

- Deep, then shallow breathing.
- Full, rapid pulse.
- Weakness.
- Dry, hot skin.
- Little or no perspiration.
- Often, loss of consciousness.

b. **Treatment.**

(1) Protect casualty from sun. Move the casualty to a cool, shady area or construct shade for the casualty.

(2) Remove clothing. Remove the casualty's outer clothing if you are not in a chemical environment.

(3) Cool casualty.

- If there is a source of cool water nearby, immerse the casualty in the water.

- If the casualty cannot be immersed, pour cool water on him. Fan him in order to promote evaporation, thus increasing the cooling effect. Also, massage his arms and legs to promote blood circulation and thus promote heat loss. Elevating his legs will also help promote circulation and help to control shock.

NOTE: The longer the casualty's body temperature remains elevated, the greater is the threat to his life. Measures to lower his body temperature should be started as soon as possible. Also, be ready to initiate rescue-breathing procedures should the casualty stop breathing.

(4) Send for help. If possible, send someone to seek the medic or other trained personnel. The medic can initiate an intravenous infusion (IV) to help restore body fluids if needed. Also, the medic can perform cardiopulmonary resuscitation (CPR) should the casualty's heart stop beating.

(5) Have casualty drink water. If the casualty is conscious and is able, have him drink at least one canteen (quart) of cool water. If the casualty can tolerate the salt and water solution (para 4-11 b (3)), have the casualty drink one quart of the solution followed by additional cool water.

(6) Evacuate. Evacuate the casualty to a medical treatment facility as soon as possible. Do not delay evacuation in order to start cooling measures.

- Perform cooling procedures en route to the facility.
- Measures to cool the body should be continued until the facility is reached.
- During transportation, the skin should be kept moist.
- The passage of air currents through an opened door of an ambulance will aid cooling.
- If regular ice bags or chemical ice bags are available, place at least two at the neck/or axilla (underarms).
- When the casualty reaches the treatment facility, further cooling measure, such as placing him in a tub of water and ice, will be carried out.

4-14. PREVENTION OF ADVERSE EFFECTS OF HEAT

Successful prevention of heat injuries depends largely on education of personnel, both those exposed to heat and those charged with the supervision of such personnel.

a. **Increase Resistance to Heat.** Specifically, prevention of heat injury involves the application of measures for increasing the resistance of exposed persons and reducing the exposure as much as practical. Resistance is increased by replenishing water and salt losses from the body as they occur, by acclimatization of individuals to hot environments, and by the maintenance of the optimum physical condition of personnel.

b. **Decrease Heat Stress.** Heat stress is decreased by:

- Reducing the workload
- Protecting the individual from the hot environment

These measures are discussed briefly in the following paragraphs.

4-15. WATER

The human body is highly dependent on water to cool itself in a hot environment. An individual subjected to high heat stress may lose water in excess of one quart per hour by sweating. Water losses must be replaced or else rapid decrease in the ability to work, rise in body temperature and heart rate, deterioration of morale, and heat injuries will occur. Water loss should be replaced preferably by periodic intake of small amounts of water throughout the work period.

a. **Moderate Activity** - **Moderate Water Requirements.** During a period of moderate activity with moderate conditions prevailing, water requirements will be one pint or more per hour per soldier. This is best taken at 20- to 30-minute intervals.

b. **Activities/Conditions Increase-Water Requirements Increase.** As activities or conditions become more severe, the water-intake need increases accordingly.

- A person working in a hot environment should drink at least one full canteen (one quart) every hour.
- A person who is performing strenuous physical labor or who is working in a very hot environment should drink one quart of water every half-hour.
- The water should be drunk in small amounts throughout the work period rather than drinking a large amount of water at one time.

c. **Water in Short Supply.** When water is in short supply, significant water economy may be achieved by limiting physical activity to the early morning, evening, and night hours when the heat load is less and sweating is reduced.

NOTE: The belief that soldiers can be taught to adjust to decreased water intake is incorrect**.**

d. **Thirsty or not Thirsty. DO NOT** rely on thirst to remind you when to drink water. People in a hot climate seldom feel thirsty enough to replace all of the water that is lost through perspiration, urination, and respiration. It is better to drink too much water than not to drink enough water.

e. **Extra Water Before the Mission.** Drink extra water before an attack or mission. The excess water in your system will help to keep you physically strong and mentally alert until the tactical situation allows you time to drink again.

f. **Chemical Protective Clothing.** A person wearing chemical protective (MOPP) clothing is especially prone to heat injury.

g. **Drinking Water Temperature.** The optimum temperature of water for drinking is 60° F ± 10°.

4-16. SALT

While significant quantities of sodium chloride may be lost by sweating, no special salt supplements are routinely required as a heat injury countermeasure. That quantity of salt normally consumed with meals will satisfy most requirements.

-- CAUTION --

Personnel should NOT take salt supplements (i.e. salt tablets) without medical advice.

Too much salt in the body--salt overload—can cause vomiting, dehydration, and electrolyte imbalance.

4-17. ACCLIMATIZATION

Training programs for personnel who are unseasoned to heat should be limited in intensity and time.

- A period of approximately 2 weeks should be allowed for acclimatization with progressive degrees of heat exposure and physical exertion.

- If soldiers are required to perform heavy physical work before being properly acclimatized:

  -- The work is poorly performed.

  -- Development of the capacity to work effectively is retarded.

  -- The risk of heat injury and disability is increased.

- A period of acclimatization is necessary regardless of the individual's physical condition.

The better the person's physical condition however, the quicker acclimatization is completed.

a. **The Process of Acclimatization.** Acclimatization to heat begins with the first exposure and is fairly well developed by the end of the second week.

- Individuals who are unusually susceptible to heat will require additional time for acclimatization.

- Full acclimatization (the ability to perform a maximum amount of strenuous work in the heat) is attained most quickly by graded, progressively increasing work in the heat.

- Resting for 3 or 4 days in the heat with activity limited to that required for existence results in definite, but only partial, acclimatization.

- Physical work must be accomplished, but should be limited to brief periods.

- A day or two of intervening cool weather will not interfere significantly with acclimatization.

b. **Work-Rest Schedule.** A schedule should be established which provides for alternating work and rest periods. Although advantage should be taken of the cooler hours in accomplishing a portion of the work, the schedule should include gradually increasing exposure during the hotter parts of the day rather than complete exclusion of work at that time.

- The work period should be divided so that a person works and rests in alternating periods.

- When necessary for the accomplishment of a given task, two details can be arranged to alternate work.

c. **Water.** Adequate water must be provided at all times.

d. **Meals.** Under conditions of heat stress, meals should be cool rather than hot. The heaviest meal should be served in the evening rather than at noon. An hour of rest following the noon meal is beneficial.

e. **Desert and Jungle Acclimatization.** Acclimatization to a hot, dry (desert) environment increases markedly the ability of men to work in a hot, moist (jungle) environment. Regulated physical activity is required, however, for proper acclimatization.

f. **Continual Heat Watch.** While carefully and fully developed acclimatization increases resistance, it does not confer complete protection against ill effects of heat.

g. **How Long Acclimatization Lasts.** Once acclimatized, the soldier will retain his adaptation for about 2 weeks after leaving the hot environment. If he is not exposed to high temperatures thereafter, the acclimatization will then decrease with the major portion usually being lost within one month.

4-18. WORK SCHEDULES

Work schedules must be tailored to fit the climate, the physical condition of personnel, and the military situation. Close supervision by medical officers, responsible commanders, and experienced paramedical personnel is essential in achieving maximum work output with minimum hazard. Certain general principles must be considered when planning work schedules.

a. **The Workload.** The amount of heat produced by the body increases directly with increasing work. Therefore, reduction of workload markedly decreases the total heat stress.

b. **The Workload in the First Days of Acclimatization.** 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 acclimatization.

c. **Heavy Work.** While decisions to modify work schedules must be governed by the particular local situation, work should be scheduled for the cooler hours of the day, such as early morning or late evening.

d. **Work-Rest Periods.** Alternate work and rest periods. Rest periods are discussed in paragraph 4-19.

e. **Night High Temperature.** Exposure to high temperature at night as well as in the daytime will decrease the amount of work that men can perform effectively.

f. **Water in Short Supply.** 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 evenings will allow much more work to be accomplished for the expenditure of a given amount of water than working during the hottest hours of the day.

g. **Direct Sun Work.** Work in the direct sun should be avoided as far as possible on hot days.

h. **Standing in Heat.** Unnecessary standing at attention in the heat should be avoided because continued standing places an added burden on the circulation.

i. **Working When Temperature** is High. When the temperature is excessively high, physical work should be curtailed or, under extremely severe conditions, suspended.

- The temperature at which work should be curtailed or suspended depends on:

  -- The humidity.
  -- Heat radiation.
  -- Air movement.
  -- Character of the work.
  -- Degree of acclimatization of personnel.
  -- Other factors.

- Heat casualties may be expected with wet bulb temperatures of 75°°F and above unless preventive measures are instituted.

- Overexertion can cause heat injury at even lower temperatures.

4-19. REST BREAKS

Rest breaks help a person's body to cool off.

- A working person in a moderately hot environment may need to take a 5-minute rest break in a shaded area after each 25-minute work period.

- A person performing heavy work in a hot environment should rest about 30 minutes for each hour he works.

These breaks should be taken only if the tactical situation allows time to stop and rest.

4-20. CLOTHING

a. **Clothing as Protection.** Clothing protects the body from direct solar radiation (sunlight). Unprotected skin may develop serious sunburn.

- When possible, clothing should be light and loose fitting, especially at the neck, wrists, and lower legs.

  -- This allows for better air circulation, which helps to cool the body.

- Soldiers wearing full chemical protective gear are especially prone to heat injury.

  -- The protective clothing traps much of the heat energy produced by the body.

b. **Clothing in a Shaded Area.** When an individual in a hot environment is protected (shaded) from the sun's rays, the person is better off wearing the least allowable amount of clothing since clothing decreases air movement over the skin.

4-21. SPECIAL CONSIDERATIONS IN RECRUIT TRAINING

Basic trainees comprise a special group of unseasoned personnel who require particular attention because of the unusual physical stresses involved in basic training in summer heat.

- Adjustment to this stress is difficult and must be taken into account in planning training schedules.

- Curtailment of work and scheduling strenuous training activities for the coolest parts of the day will yield greater efficiency and less disruption of training than will ignoring the weather in the interest of completing a heavy schedule.

- Heat casualties occur most frequently during the first 2 weeks of basic training and during the bivouac week.

- They are associated especially with firing on the rifle range, range marches, and retreat parades.

- Particular attention should be paid to decreasing the heat stress accompanying these activities.

a. **Recruit Heat Casualties.** Recruit heat casualties tend to occur in groups within particular units. Responsible commanders and medical officers should promptly investigate each case to determine the unsafe practice or condition responsible and institute measures to prevent additional cases.

b. **Protecting Soldiers.** Protecting soldiers from the environment also includes such simple but frequently overlooked things as marching troops over grass rather than concrete and operating in such shade as is available.

4-22. EVALUATING THE ENVIRONMENT

Four basic factors that determine the degree of heat stress exerted by the environment are:

- Air temperature.
- Relative humidity.
- Air movement.
- Heat radiation.

a. **Air Temperature Reading.** The air temperature is read from an ordinary-dry bulb-thermometer. The thermometer should be in the shade so that the reading is affected only by the air temperature.

b. **Relative Humidity + Air Movement.** The combined effect of relative humidity and air movement is measured by the wet bulb temperature.

- The wet bulb temperature is the reading of a thermometer when the bulb is covered with a wet wick and a current of air (wind) is passed over the wick.

- The amount of heat lost by the bulb under these conditions, and thus the reading of the thermometer, is affected by both temperature and humidity.

- The wet bulb temperature is always below the dry bulb temperature except when the relative humidity is 100 percent, at which point both temperatures are equal.

c. **The Radiant Heat Factor.**

(1) Radiant heat defined. Remember that radiation is the transfer of heat as infrared heat rays from one object to another without physical contact.

- The human body loses heat by the radiation of heat waves from the body to cooler objects nearby such as ceilings, floors, and walls.

- If these objects are at a higher temperature, an individual's body absorbs the heat--also by the process of radiation.

- The temperature of the air has no relation to the radiation of heat to and from objects.

-- That is why skiers can remove their shirts and be warm in bright sunshine even though the air temperature is low. The radiant heat from the sun warms them.

(2) The radiant heat factor. The radiant heat factor can be determined using a "black globe" thermometer or by a radiometer.

- The globe thermometer is the simpler instrument.

- It consists of a 6-inch hollow copper sphere painted flat black with an ordinary thermometer inserted so that the temperature at the center of the sphere can be measured.

4-23. ADVANTAGES AND DISADVANTAGES OF EACH MEASUREMENT

Because of the difficulty in recording all three of these measurements and combining the readings into a single index as a measure of overall heat stress, usually only the dry or wet bulb temperatures are used.

a. **Limitation of Dry Bulb Temperature Measurement.**

- The dry bulb temperature is, in general, a poor indication of thermal stress because it is not affected by humidity, air movement, or radiation.

- The wet bulb temperature is a better index since it includes the humidity factor as well as the air temperature.

b. **Example.** For example, work that is relatively easy at a dry bulb temperature of 96° F with a relative humidity of 50 percent (80° F wet bulb) becomes almost impossible at the same dry bulb temperature when the relative humidity approaches 100 percent (96° F wet bulb). At a given wet bulb temperature, the dry bulb temperature can vary upward over a wide range without much physiologic or psychological effect on an individual.

c. **Limitations of Wet Bulb Temperature Measurement.** However, the wet bulb temperature is not a good index of the heat stress imposed upon individuals exposed to the sun. Air movement also is not taken into account in these measurements.

d. **A Single Index.** Many attempts have been made to devise a single index combining all four of these factors, an index that would be simple and could be used without elaborate equipment or training of personnel. The wet bulb globe temperature (WBGT) index provides such a standard.

4-24. WET BULB GLOBE TEMPERATURE (WBGT) APPARATUS

a. **Parts of the Apparatus.** The WBGT apparatus consists of:

- A stationary wet bulb thermometer exposed to the sun and to the prevailing wind.

- A black globe thermometer similarly exposed.

- A dry bulb thermometer shielded from the direct rays of the sun.

b. **Location and Setup.** The apparatus is set up at a location representative of the conditions to which soldiers are exposed. The wet bulb and globe thermometers are suspended in the sun at a height of 4 feet above ground for at least 20 minutes before readings are taken.

c. **Dry Bulb Thermometer.** The dry bulb thermometer is a standard thermometer with the bulb shaded, but still left exposed to the wind.

d. **Wet Bulb Thermometer.** The wet bulb thermometer is a standard laboratory glass thermometer with its bulb cover with a wick (heavy white corset or shoestring).

- The wick dips into a flask or bottle of clean, preferably distilled, water.
- The mouth of the flask or bottle should be about three-fourths of an inch below the tip of the thermometer bulb.
- The water level in the flask should be high enough to ensure thorough wetting of the wick.
- The water should be changed at least daily after rinsing out the flask and washing the wick with soap and water.
- To avoid erroneous readings, the water and wick must be free of all salts and soap.

e. **Globe-Thermometer Apparatus.** The globe-thermometer apparatus consists of a 6-inch hollow copper sphere painted flat black on the outside and containing a thermometer with its bulb at the center of the sphere.

- The thermometer stem protrudes to the outside through a rubber stopper tightly fitting into a brass tube soldered to the sphere.
- The sphere usually has two small holes near the top used for suspending the sphere with wire or strong cords.
- The globe must be kept dull black at all times.
- Keep the globe free of dust or rain streaks by dusting, washing, or repainting as necessary.

f. Methods to Set Up a WBGT Apparatus. There are several methods for setting up a WBGT apparatus. Figure 4-1 shows one such method.

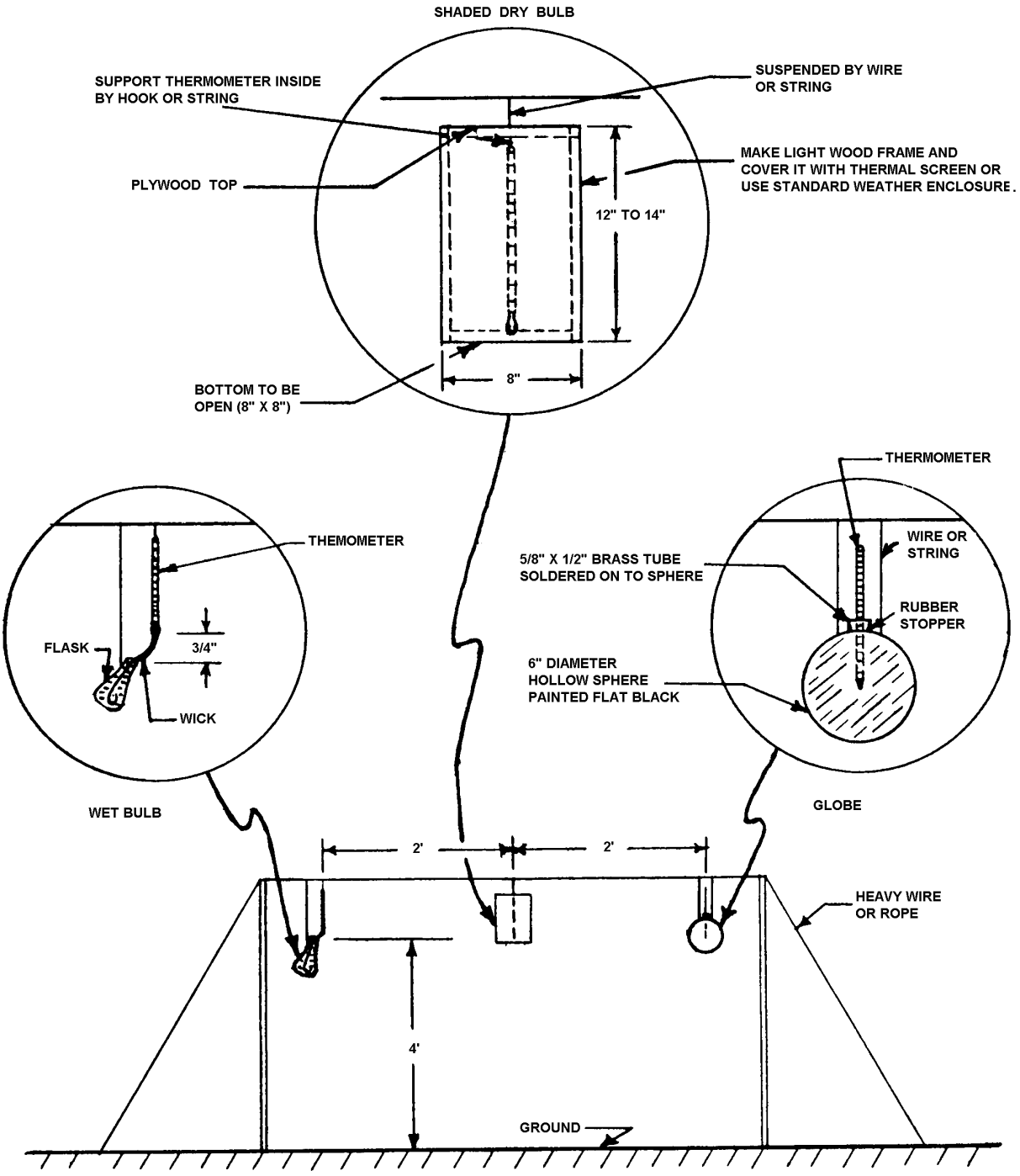


Figure 4-1. WBGT field apparatus.

4-25. WET BULB GLOBE TEMPERATURE (WBGT) INDEX

The wet bulb globe temperature (WBGT) index is a method of combining the three readings obtained from the WBGT apparatus. All readings are to be in degrees Fahrenheit. The index, however, is a number--not a temperature.

- Formula. The WBGT Index is computed as follows:

a. Formula. The WBGT Index is computed as follows:

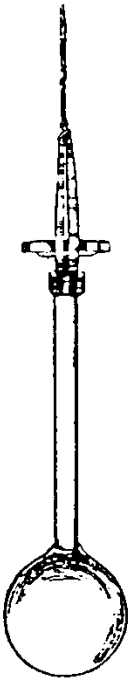
WBGT = 0.7 x wet bulb temperature
+0.2 x black globe temperature
+ 0.1 x dry bulb temperature (shade)

b. Example. An example of a WBGT computation follows:

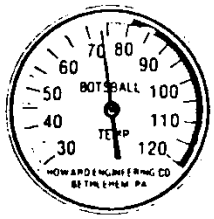
Wet bulb temperature = 80º F
Black bulb temperature = 105º F
Dry bulb temperature = 90º F
80 x 0.7 = 56

4-26. OTHER INDEXES

a. **Wet Globe Temperature (WGT) Index.** The wet globe temperature index is determined using a Botsball apparatus (Figure 4-2).



HANGING BOTSBALL



BOTSBALL DIAL

Figure 4-2. Botsball apparatus.

- The Botsball consists of a thermometer with a dial gauge whose bulb is enclosed in a small copper globe.

- The globe is covered by a black cloth that is kept moist by water kept in a metallic cylinder surrounding the stem of the thermometer.

- The Botsball is hung in an appropriate location, and the WGT index is read directly from the dial.

- The Botsball device is used only in certain areas such as jungle type environment.

- If humidity is greater than 30 percent and there is little or no wind, the Botsball device is acceptable for use.

- However, there is a need to periodically correlate the WGT with the WBGT Kit.

- In most areas, the WGT index is not as accurate an indicator of heat injury hazard as the WBGT index.

b. **Heat Category Number.** The heat category number is used to indicate the general degree of heat injury hazard.

- Often, the heat category number is used instead of the WBGT when informing troops about the present risk of heat injury.

- Table 4-2 shows the heat category numbers with the matching WBGT index ranges.

4-27. USE OF THE WBGT INDEX

The proponents of the WBGT index have proposed the following as a standard for application of the index.

THE WBGT INDEX and WORK / EXERCISE	
WBGT Index	**EXERCISE / WORK**
WBGT over 78 Heat category 1	For unseasoned personnel, use discretion in planning heavy exercise.
WBGT 82 Heat category 2	For unseasoned/unacclimatized personnel, use caution in planning heavy work or exercise.
WBGT 83 Heat category 3	For unseasoned personnel in the first 2 weeks of training, suspend strenuous exercises such as marching at standard cadence. Avoid outdoor classes in the sun.
WBGT 88 Heat category 4	For all recruits and other trainees with less than 12 weeks training in hot weather: -- Curtail strenuous exercise. For seasoned personnel (after acclimatization each season), schedule limited activity of not more than 6 hours each day.
WBGT 90 Heat category 5	For unacclimatized personnel, suspend physical training and strenuous exercise. For acclimatized personnel: -- Have boots unbloused. -- Take other measures to prevent heat injury. Order soldiers to drink at least 2 quarts of water per hour.

NOTES

- **WARNING:** Add 10 degrees to the WBGT index for personnel wearing MOPP overgarments.
- **Heat categories 4 and 5:** Workers may be divided into shifts, one shift working while the other shift rests.

Table 4-2. Wet Bulb Globe Temperature index.

4-28. RECOMMENDED WATER INTAKE AND REST BREAKS

Recommended minimum water intake and rest breaks for various levels of heat injury hazard are given in table 4-3. The information is taken from GTA 8-5-50, Heat Injury Prevention and First Aid, June 1990. This graphic training aid (GTA) is available through the U.S. Army Training! Visual Support Centers (TIVISC).

HEAT CONDITION / CATEGORY	WBGT INDEX	WATER INTAKE QUARTS / HOUR	WORK / REST CYCLE-MINUTES
1	78° - 81.9° F	At least 1/2	Continuous
2	82° - 84.9° F	At least 1/2	50 / 10
3	85° - 87.9° F	At least 1	45 / 15
4	88° - 89.9° F	At least 1 1/2	30 / 30
5	90° F & above	At least 3	20 / 40
REMEMBER. Soldiers in MOPP gear or body armor have a heat stress of approximately 10 degrees greater than the WBGI index.			

Table 4-3. Heat injury prevention chart: water intake and work/rest cycles.

4-29. EDUCATION

As noted previously, prevention of heat casualties depends largely upon the education of exposed personnel and especially upon supervision by informed, responsible commanders.

- Every individual exposed to unaccustomed high temperatures should be informed of heat injury and the potentially serious results, and how it can be prevented.

- Supervisors and responsible officers must, in addition, be able to identify environmental conditions under which adverse effects of heat are likely to occur.

  -- Supervisors should recognize the earliest signs of heat injury.

  -- Supervisors should take appropriate action to prevent the development of heat injury cases.

- All personnel should be able to apply effective first aid. Mental confusion and over activity often precede collapse from heatstroke.

- Supervisors must be alert to detect this condition, enforce rest, and obtain medical assistance promptly.

- Responsible medical officers should assist commanders in the development of local programs for heat injury prevention and continuously observe and advise in its applications.

Continue with Exercises

EXERCISES, LESSON 4

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Which of the following cold injuries occurs only when the temperature is below freezing?

   a. Trench foot
   b. Immersion foot
   c. Frostbite
   d. Chilblains

2. Which of the following is a sign of frostbite?

   a. Stiff, sore joints
   b. Numbness of the exposed part
   c. Profuse sweating
   d. Severe muscle cramps

3. Which of the following is a medical emergency that can result in death within minutes?

   a. Immersion foot
   b. Trench foot
   c. Chilblains
   d. Hypothermia

4. All of the following, EXCEPT that in choice _____ below, increase the likelihood of cold injury occurring.

   a. Fatigue
   b. Prior cold injury
   c. Use of alcoholic beverages
   d. Moderate physical activity

5. What effect, if any, does a decrease in physical activity generally have on the exposure time necessary to produce cold injury?

   a. Decreases the exposure time needed to produce a cold injury
   b. Increases the exposure time needed to produce a cold injury
   c. Has no effect on the time needed to produce a cold injury

6. a. How does wind moving across the body promote the loss of body heat?

   b. When the wind speed increases, what happens to the body's heat loss rate?

   c. What happens to body heat in wind when the air temperature is below freezing?

7. The commander can help to prevent cold injury in the troops by:

   a. Appointing cold injury control officers
   b. Inspecting troops to ensure that clothing is worn properly
   c. Using meteorological data when planning work schedules
   d. Doing all of the above

8. When the temperature of the surrounding, stationary air is below the body temperature, the body will:

   a. Gain heat by conduction
   b. Lose heat by conduction

9. The cold weather uniform should fit military personnel:

   a. Tightly
   b. Snugly
   c. Loosely
   d. “Form fitting”

10. Which of the following is the more important phase of treatment for a heatstroke casualty?

    a. Loosening the casualty’s clothing
    b. Administering a saline (salt and water) solution
    c. Elevating the casualty’s feet
    d. Immersing the casualty in cool water

11. During cold weather duty, cold injury will most likely occur in:

    a. Static defense or holding action
    b. Active offense or defense
    c. Reserve unit in support of attacking units
    d. Reserve unit in support of units fighting a delaying action

12. You are monitoring a rising WBGT Index. You should plan to suspend unshaded outdoor classes when the index passes:

    a. 75
    b. 80
    c. 83
    d. 90

13. Treatment of heat cramps mainly involves:

    a. Replacing lost fluid and salt
    b. Administering an intravenous infusion
    c. Massaging the arms and legs
    d. Lowering the body temperature

14. One danger sign indicative of impending heatstroke during hard labor in a hot climate is:

    a. Profuse sweating
    b. Stoppage of sweating
    c. Muscular pains
    d. Pale, damp skin

15. Salt routinely lost from profuse sweating should be replaced by:

    a. Consuming 1 or 2 salt tablets with each meal
    b. Eating regular meals
    c. Receiving IV solutions
    d. Adding salt to your canteen each time you fill it up

16. List two ways to decrease heat stress.

    a. _____

    b. _____

17. Which of the following choices best describes the symptoms of a victim of heat exhaustion?

    a. Severe cramps in the muscles of the lower extremities and abdominal wall.
    b. Weakness, faintness, vomiting, and profuse sweating.
    c. High body temperature, unconsciousness, convulsions, and absence of sweating.

18. A casualty with _____ should be evacuated to a medical treatment facility as quickly as possible.

a. Heatstroke
b. Heat exhaustion
c. Heat cramps

19. Your health interest under heat stress conditions will be best served if you drink:

a. Small amounts of water at frequent intervals
b. Large quantities of water just before meals and only small amounts at other times.
c. Large quantities of water in the early morning and the late evening with little or no water consumed when working in direct sunshine.
d. Small amounts of water during meals

20. A group of soldiers are working in a hot environment. The heat condition has gone from category 4 to category 5. The work is necessary. What can be done to help protect the soldiers from heat injury?

a. Divide the soldiers into shifts and have them take turns performing the work.
b. Order the soldiers to drink at least two full canteens of water per hour.
c. Have soldiers unblouse their boots and loosen their clothing
d. All of the above

21. Which type of heat injury is considered a medical emergency that requires prompt treatment?

a. Heat exhaustion
b. Heatstroke
c. Heat cramps
d. None; heat injuries lower worker output but are not dangerous

22. A soldier in good physical condition does not need to go through the process of acclimatization for heat.

a. TRUE
b. FALSE

23. Several recruits in a unit have experienced heat cramps. The responsible commander or medical officer should

_____

_____

_____

24. You are making a salt and water solution for a soldier with heat injury. To make the solution, you should dissolve ____ of salt in one quart of cool water.

a. 1/4 teaspoon
b. 1 teaspoon
c. 1/4 tablespoon
d. 1 tablespoon

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 4

1. c (para 4-1a(3))

2. b (para 4-5)

3. d (para 4-1a(4))

4. d (para 4-2f, g, h, j)

5. a (para 4-2h)

6. a. Wind removes the thin layer of warm air next to the skin
   b. The body's rate of heat loss increases, meaning the body loses heat faster
   c. The wind removes body heat faster than the body can replace heat, and frostbite may occur. (para 4-3a)

7. d (para 4-4a, b, d)

8. b (para 4-8c)

9. c (para 4-2d)

10. d (para 4-13b(3))

11. b (para 4-2c)

12. c (table 4-2)

13. a (para 4-11b(3))

14. b (para 4-13a)

15. b (para 4-16)

16. a. Reduce the workload

    b. Protect the individual from the hot environment. (para 4-14b)

17. b (para 4-12a)

18. a (para 4-13b(6))

19. a (para 4-15)

20. d (table 4-2)

21. b (para 4-13)

22. b (para 4-17)

23. Investigate each case to determine and correct the unsafe practice or condition responsible for the heat injuries. (para 4-21a)

24. a (para 4-11b(3))

End of Lesson 4

LESSON ASSIGNMENT

LESSON 5	Arthropod-Borne Diseases
LESSON ASSIGNMENT	Paragraphs 5-1 through 5-50
LESSON OBJECTIVES	After completing this lesson, you should be able to:

5-1 Identify the ways in which arthropods affect the health of man.

5-2 Recognize the categories of ARBO diseases and the control methods for each.

5-3 Differentiate between biological and mechanical transmission of disease.

5-4 Identify the causative agents and infective mechanisms of selected ARBO diseases.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 5

ARTHROPOD-BORNE DISEASES

Section I. INTRODUCTION TO MILITARY MEDICAL ENTOMOLOGY

5-1. GENERAL

a. **Definition.** Entomology is the science concerning the study of insects. In its broader and more practical application, entomology includes the study of many arthropods, which are not true insects. Military medical entomology is the study of those arthropods capable of causing injury or transmitting diseases, which may affect the fighting strength of the Army. Rats, mice, and other rodents often play an important role in the spread of disease and in providing harborage for insects. The broader area of study, including rodents and other vertebrates, is known as medical zoology. Medical entomology, then, is a branch of medical zoology.

b. **Arthropods and World History.** Arthropods have played a dramatic role in the transmission of disease, not only in military history, but in world history as well. The infamous plague, or "Black Death," epidemic of the 14th century killed one-fourth of the population of Europe. During the Spanish-American War in 1898, seven men died---mostly from yellow fever--to each one who died as a result of enemy action.

c. **Arthropods and Military Operations Today.** Our military experience in more recent years has been less catastrophic, because of the advent of new and improved techniques and medicines, but arthropod-borne diseases have been a major consideration in all recent U.S. military operations.

d. **American Soldiers Deployed Worldwide.** Because of the nature of our political commitments, American soldiers are frequently deployed to regions of the world in which disease-carrying arthropods flourish. The diseases involved are usually endemic; i.e., they exist at a low level among the natives at all times. The local population has had an opportunity to develop a degree of immunity. The American soldier, however, raised in a relatively sanitized environment, seldom has an opportunity to develop such immunity and readily becomes ill when exposed to the agents of these diseases. The importance of arthropod-borne diseases cannot be overemphasized in planning for United States involvement in overseas operations.

5-2. ARTHROPODS

Invertebrate animals in the *Phylum Arthropoda* embrace all arthropods. The arthropods have an exoskeleton and jointed appendages. A few examples of these "joint foot" creatures are lobsters, shrimp, grasshoppers, butterflies, spiders, and disease-bearing

species discussed in this publication. Arthropods are grouped into classes, two of which are important here.

a. **Class Insecta.** This class contains the true insects. Adult insects have three distinct body regions: head, thorax, and abdomen. The thorax has three pairs of jointed legs attached to it. Many species also have either one or two pairs of wings attached to the thorax. Insects of military importance in disease transmission include mosquitoes, fleas, flies, and lice.

INSECTS (Class Insecta) of Military Importance in Transmission of Disease

- Mosquitoes
- Fleas
- Flies
- Lice

b. **Class Arachnida.** Adult arachnids have two distinct body regions: cephalothorax and abdomen. The cephalothorax has four pairs of legs attached to it. The arachnids include spiders, mites, and ticks. Mites and ticks are the only arachnids that transmit disease organisms. Arachnids are sometimes incorrectly called insects.

ARACHNIDS (Class *Arachnida)* of Military Importance in Transmission of Disease

- Mites
- Lice

c. **Sub classification of the Classes.** Each class of arthropods is further divided into orders, families, and genera, and each genus is divided into the various species. The species division is usually a true biological grouping, in that the members have common characteristics and do not mate with members of any other species.

5-3. HOW ARTHROPODS AFFECT MAN'S HEALTH

Aside from the fact that arthropods are responsible for transmitting some of the deadliest known diseases, arthropods affect man's health in a number of ways.

a. **Direct Injury.** Arthropods are often capable of inflicting painful injuries to man through their bites. They also frequently cause injury to the sense organs, such as the eye, the ear, and the nose.

b. **Envenomization.** Many arthropods are capable of injecting toxins or venoms into or on the skin, causing a wide variety of symptoms. Examples include wasps, scorpions, spiders (particularly the black widow and the brown recluse), blister beetles, centipedes, bees, and countless others.

c. **Dermatosis.** Dermatosis, or skin irritation, frequently results from arthropods, particularly those which burrow into the skin (such as ticks and mites) and set up secondary infections from scratching or from the breaking off of body parts in the skin.

d. **Allergies.** An allergy is the hypersensitivity of an individual to a specific substance.

- Continued exposure to substances such as dead insect bodies or insect venoms may cause an individual to develop an allergy to these substances.

- Allergies to the sting of ordinary bees and wasps are sometimes so severe as to cause death.

e. **Myiasis.** Myiasis is an invasion of the tissues by fly larvae. Specific myiasis is caused by parasitic flies such as the screwworm fly and botfly, whose larvae require living flesh as a specific host. Accidental myiasis is caused by larvae hatching from eggs laid by ordinary flies in wounds or around the eyes.

f. **Entomophobia.** Entomophobia is an intense, abnormal fear of insects or other arthropods. Individuals suffering from entomophobia may experience nervous disorders, and medical attention may be required. Entomophobia should not be dismissed as trivial; affected individuals should be handled with understanding.

HEALTH
Affected by Arthropods

- Direct injury
- Envenomization
- Dermatosis
- Allergies
- Myiasis
- Entomophobia

5-4. ARTHROPOD-BORNE PATHOGENS

Arthropods serve as vectors for the transmission of some species of almost every type of disease agent.

a. **Bacteria.** An example of a disease transmitted by an arthropod- borne bacterium is plague, which is caused by *Yersinia pestis,* spread by the rat flea.

b. **Viruses.** A number of viral diseases, known as arboviral diseases, are transmitted by arthropods. Included are:

- Dengue
- The encephalitides

- Yellow fever
- Sandfly fever

c. **Rickettsiae.** Rickettsial diseases include:

- Typhus
- Scrub typhus
- Rocky mountain spotted fever

d. **Protozoa.** The classical example of a protozoan disease transmitted by arthropods is malaria, which is caused by several species of the genus *Plasmodia,* harbored in the body of various mosquitoes.

e. **Nematodes.** The filarial diseases are caused by microscopic nematodes (roundworm s) known as filariae, which are transmitted by the bite of a mosquito or fly.

ARTHROPOD-BORNE
Pathogens

- Bacteria
- Viruses
- Rickettsiae
- Protozoa
- Nematodes

5-5. MECHANISMS OF DISEASE TRANSMISSION

Arthropods are capable of transmitting disease agents by two methods: passive/mechanical or active/biological.

a. **Passive/Mechanical Transmission.** In passive/mechanical transmission, the arthropod come into contact with infectious agents, which adhere to the body or hairs of the bug as he travels from manure pile to outdoor latrine, garbage cans, or other source of filth. Gaining access to food or eating utensils, the arthropod then deposits the organisms where they will be eaten by humans or animals.

b. **Active/Biological Transmission.** In active/biological transmission, the pathogenic organism actually undergoes a portion of its life cycle in the body of the arthropod. There are four mechanisms, by which an arthropod can actively, or biologically transmit a disease.

(1) Inoculation. Certain bloodsucking arthropods, such as the mosquito, insert a proboscis into the victim in order to withdraw the blood meal. In so doing, the insect also injects disease organisms along with its saliva into the victim's bloodstream.

(2) Regurgitation. Some arthropods regurgitate, or vomit, a portion of their stomach contents into the wound made for feeding. These stomach contents often contain large masses of disease organisms.

(3) Defecation. Many arthropods defecate while feeding. The fecal material, containing disease organisms, is then introduced into the wound made by the arthropod--usually by scratching the irritated area.

(4) Contamination with crushed tissue. The biting of an insect causes an itching sensation, which normally compels the bitten person to scratch. Scratching often crushes the insect, causing the introduction of crushed tissues---containing disease organisms--into the wound.

MECHANISMS
by which
Arthropods transmit disease

- Inoculation
- Regurgitation
- Defecation
- Contamination with crushed tissue

5-6. CATEGORIES OF ARTHROPOD-BORNE DISEASES

Arthropod-borne diseases may be classified by a number of ways: by the type of infective organism, that is., bacteria, viruses, rickettsia, and so forth; by the type of vector, that is mosquito, fly, tick, flea, and so forth.; or by the symptoms of the disease or the part of the body affected, that is., the central nervous system, the lymphatics, the circulatory system, etc. For convenience, the diseases discussed in this text will be considered according to the following classification:

- Mosquito-Borne Diseases
- Fly-Borne Diseases.
- Flea-Borne Diseases.
- Tick-Borne Diseases.
- Mite-Borne Diseases.
- Louse-Borne Diseases.

Section II. MOSQUITO-BORNE DISEASES

5-7. GENERAL INFORMATION

The mosquitoes make up the most important group of disease vectors. Mosquitoes transmit numerous diseases that have military importance. Some of these are malaria, yellow fever, dengue fever, encephalitides viruses, and filariasis.

5-8. IDENTIFICATION

Mosquitoes are two-winged insects, which, with few exceptions, are small and fragile and have a body length of from 3 to 6 mm.

- They may deposit eggs in almost any body of standing water.
- Some species deposit their eggs in soil, which is often flooded.
- The larvae that emerge from the eggs subsist on matter in the water.
- Several genera of mosquitoes are of military importance as disease vectors (transmitters) (Table 5-1).

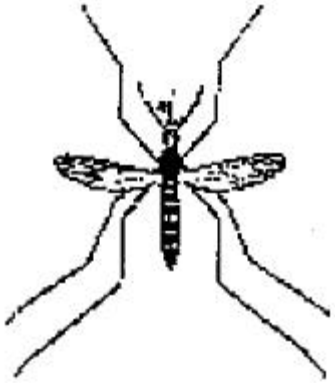


Figure 5-1. Adult mosquito.

All mosquitoes that bite man, whether disease vectors or not, are important as annoying pests and menaces to morale.

Section III. MOSQUITO-BORNE DISEASES - MALARIA

5-9. DESCRIPTION

a. **Identification.** Malaria is a group of diseases resulting from infection by protozoans in the *Genus Plasmodium.*

b. **Signs/Symptoms**. The disease in humans is characterized in the acute stages by intermittent fever, profuse sweating, and chills.

c. **Signs/Symptoms in Troops.** The classical picture of regular chills and fever is infrequent among troops who have recently been taking malaria suppressive medication.

		MOSQUITO VECTOR GENUS					
Disease	**Reservoir**	***Anopheles***	***Aedes***	***Culex***	***Culiseta***	***Haemagogus***	**Principal areas of occurrence**
Dengue	Arboreal animals?		X				Far East, India, Caribbean Islands, Venezuela
Encephalitides Eastern equine	Wild birds, domestic fowl		X		X		Western hemisphere
Japanese B	Wild birds, swine	---	---	X	---	---	Far East, India
Murray Valley	---	---	---	X	---	---	Australia, New Guinea
St. Louis	Wild birds, domestic fowl	---	---	X	---	---	U.S., Trinidad, Panama
Western equine	Wild birds, domestic fowl	---	---	X	---	---	Western hemisphere
Filariasis	Man	X	X	X	---	---	Asia, Central and South America
Malaria	Man	X	---	---	---	---	Tropics and Subtropics
Yellow fever	Monkeys, marmosets	---	X	---	---	X	Tropics of the Americas and Africa

Table 5-1. Principal mosquito-borne diseases, vectors, and areas of occurrence.

- The triad of headache, backache, and fever, with or without chills, is the commonest symptom complex in these individuals.

- Chronic cases exhibit:

  -- Anemia.
  -- Enlargement of the spleen.
  -- Other serious, often fatal, complications.

5-10. HISTORY

Malaria is an ancient disease and is one of the most important preventable diseases of man.

a. **Development of Civilization.** Malaria was well described by Hypocrites in the third century B.C. Occurring throughout the tropical and subtropical areas of the world, it has postponed the development of large regions of the earth for centuries and has undermined the culture and welfare of many countries from ancient Greece to modern times.

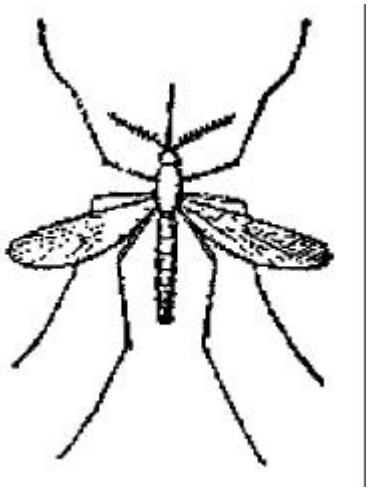


Figure 5-2. Adult female mosquito.

b. **Health Hazard.**

- Malaria was the most serious health hazard encountered by American troops in the South Pacific area during World War II, where about 100,000 men were infected, and the success of the military campaign was jeopardized for a short time.

- In Southeast Asia those United States troops who did not practice effective preventive measures contracted malaria.

5-11. ETIOLOGY

a. **Four Species of Plasmodium.** There are four species of *Plasmodium* that are known to cause malaria in man: *Plasmodium vivax, P. falciparum, P. malariae,* and *P. ovale.* The diseases produced are known as vivax, falciparum, quartan, and ovale malaria respectively.

(1) Sexual cycle of the parasite. Females of certain species of *Anopheles* mosquitoes (Figure 5-3) serve as the arthropod vectors.

- When the mosquito bites, and feeds on an infected person, she ingests sexual forms of *Plasmodium* along with the blood meal (Figure 5-2).

- Fusion of a male and female *Plasmodium* pair produces a cell thatdevelops into a motile form that penetrates the stomach wall of the mosquito and encysts on the outer wall of the stomach.

- Spore forms produced in large numbers in the cyst break out and begin to migrate to the mosquito salivary gland about 10 to 14 days after the infected blood was first ingested.

- This process is referred to as the sexual cycle of the parasite.

(2) Infection development.

- The spore forms are transmitted to man when the infected mosquito bites him.

- Within humans, the spore forms enter liver cells, where they enlarge and develop large numbers of a form that then may enter the red blood cells of the human host.

-- This phase, plus the early portion of the red blood cell phase, corresponds to the incubation period of the clinical disease.

- Inside the red blood cells, the parasites develop into small, ring-shaped forms.

-- These grow rapidly and almost fill the cells.

-- Some blood forms may develop into large and small sexual forms that will infect a feeding female anopheline mosquito.

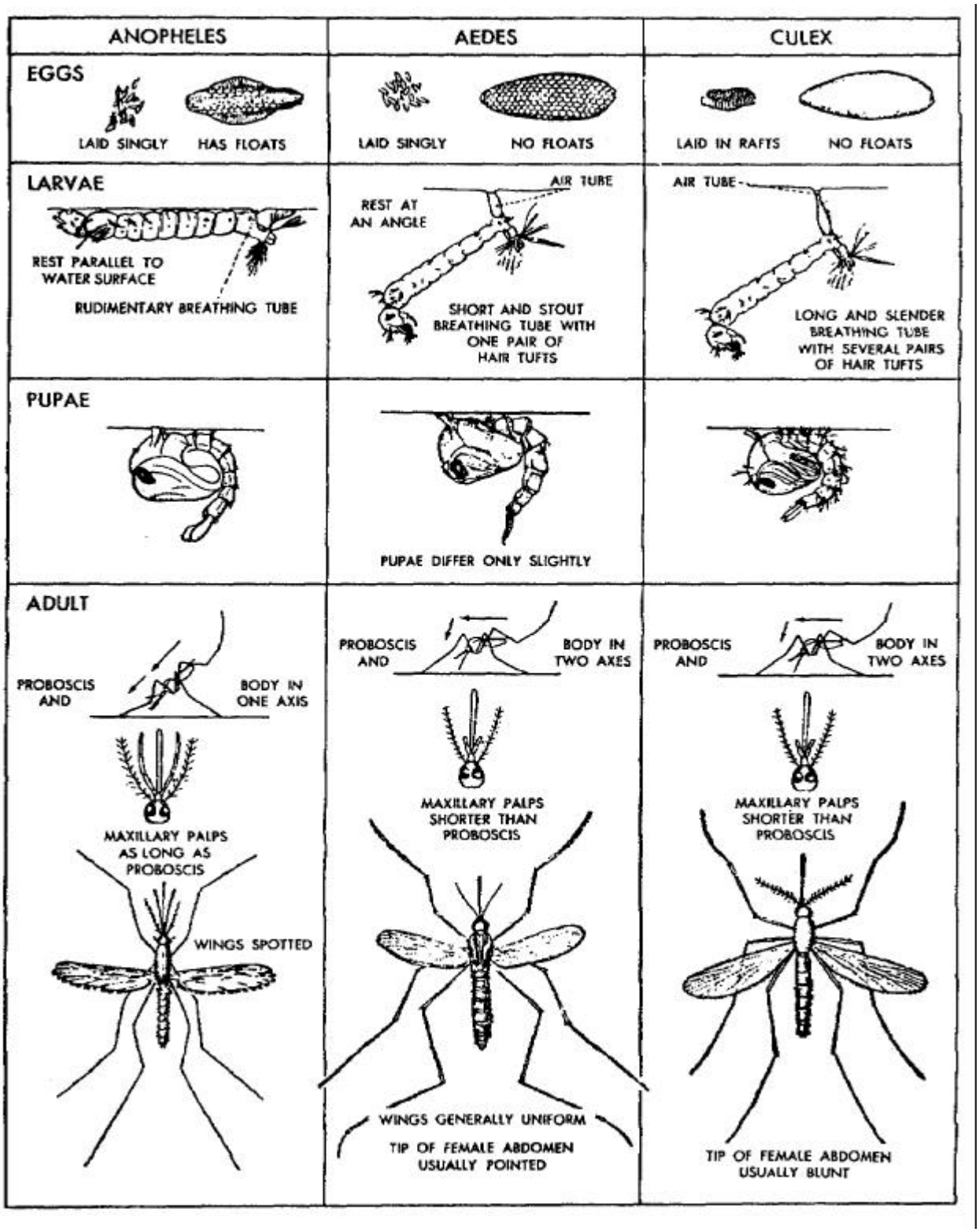


Figure 5-3. Three mosquito vectors of primary military importance.

- Blood cell rupture corresponds to the beginning of the patient's clinical fever.

- Also developed at this stage are forms of the parasite that renew the ring stage by infecting additional red blood cells of the host.

-- This is referred to as the asexual cycle, since reproduction of blood forms is continued without fertilization.

(3) Maintaining infection in man and mosquito. There are two cycles, one within the other. The larger cycle maintains the infection in the mosquito population; the other maintains the infection within the human host.

b. **Incubation Period.** Malaria is not transmissible in nature from man to man; however, it may be transmitted by transfusion of infected blood or by using contaminated hypodermic needles. The incubation period varies with the species of the infecting agent. With *P. facliparum* it will average 12 days; with *P. vivax* and *P. ovale* 14 days; and with *P. malariae* 30 days; however, it may be as long as 8 to 10 months with some strains of *P. vivax.* Mixed infections also occur.

(1) Person-to-person transmission of malaria. Many species of mosquitoes of the genus *Anopheles* are capable of transmitting malaria from person to person. Most of the endemic areas lie between 35° north and 35° south latitude.

(2) Malaria complication: blackwater fever. Malaria, particular falciparum malaria, may be complicated by an acute and very serious hemolytic state known as blackwater fever.

- Symptoms include fever, massive hemolysis, and often, acute kidney failure and uremia.

- Mortality is from 20 to 30 percent.

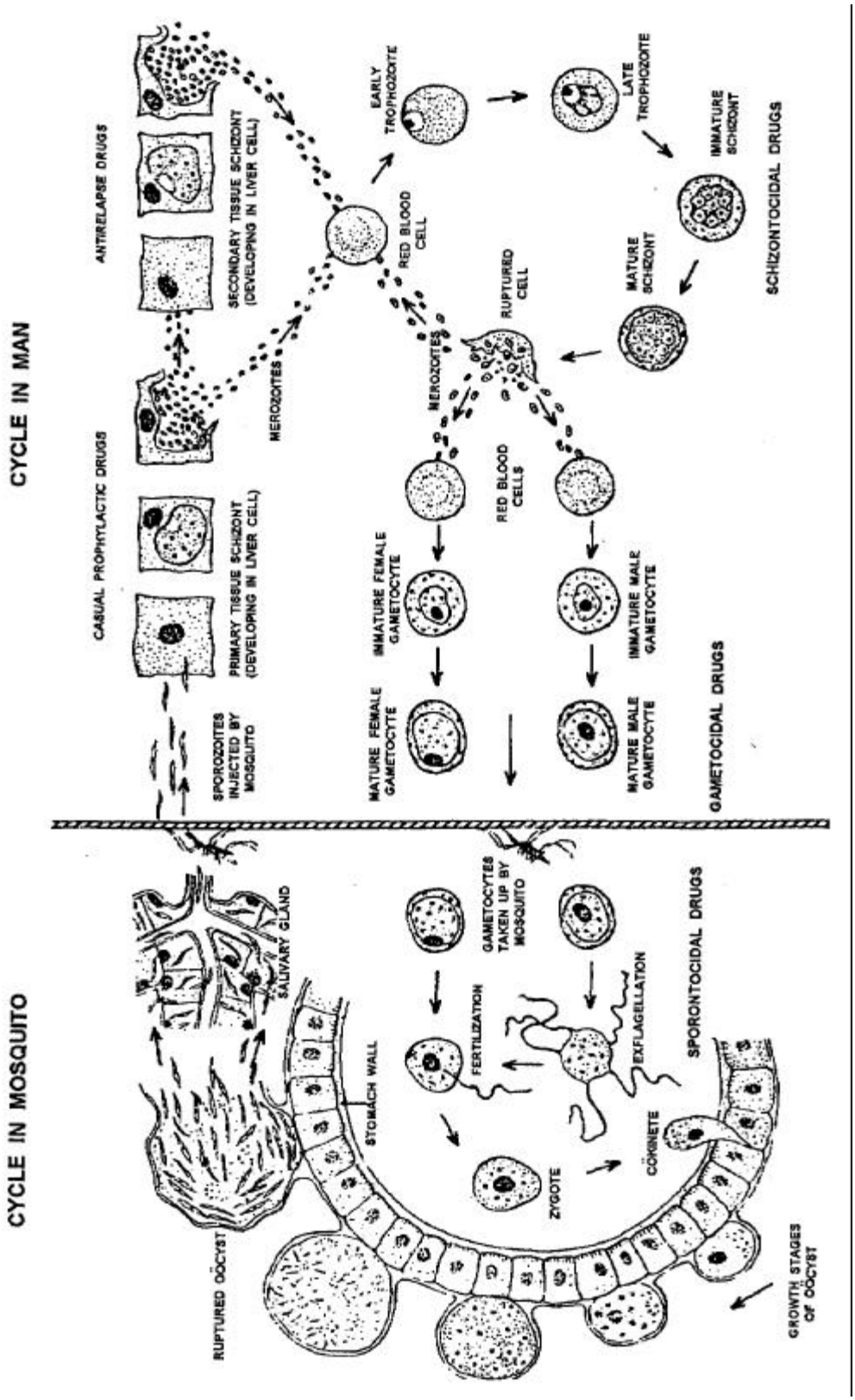


Figure 5-4. Life cycle of *Plasmodium*, the malaria parasite.

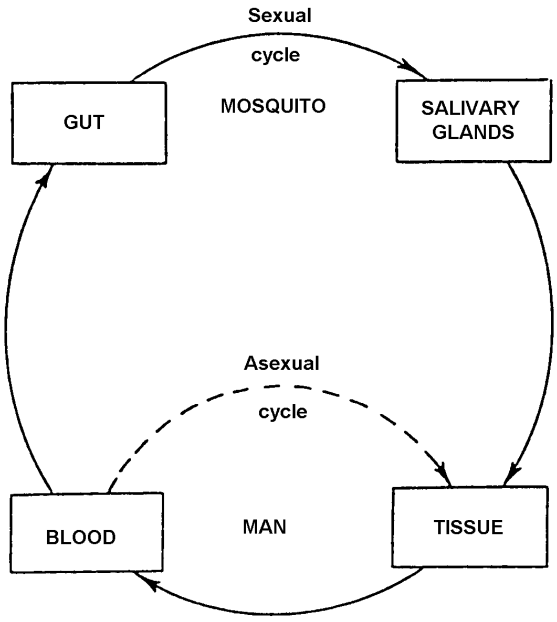


Figure 5-5. Cycles of malaria infections.

5-12. MALARIA PREVENTION AND CONTROL

a. **General.** Measures for the prevention and control of malaria fall into two categories:

(1) Prevention of bites by mosquitoes. The most effective means of malaria prevention is avoiding mosquito bites. Such prevention includes personal protective measures and the control of the mosquito and its environment. Personal protective measures comprise the first line of defense against malaria.

(2) Prevention of development of disease. This includes chemoprophylaxis and effective early treatment of cases.

b. **The Principle of Multiple Protective Measures.** Prevention of development of malaria in persons bitten by mosquito vectors is discussed in paragraph 5-14a through f. When dealing with prevention of malaria, keep the following points in mind:

- Prophylaxis should never by relied on as the sole measure for malaria prevention.

- Malaria prophylaxis provides no protection against dengue, filariasis, arthropod-borne encephalitides, and other diseases of similar epidemiology, which also may be prevalent in the malarious area.

- The nuisance to morale and the actual debilitating effects of heavy mosquito biting must not be underestimated.

CONCLUSION

It follows then, that prevention of malaria, to be effective, must rely on a variety of protective measures.

5-13. PERSONAL PROTECTIVE MEASURES

These measures are defined as those that the individual himself must apply.

- Constant and intelligent application of personal protective measures by the individual is referred to as malaria discipline.

- Personnel should be carefully indoctrinated in the principles of this approach to malaria control.

- All malaria control programs must begin with and must continuously emphasize malaria discipline, for without malaria discipline, all other control measures fall short.

a. **Insect Bar (Bednet).**

- *Anopheles* mosquitoes are essentially night biters and can bite more easily when a soldier is asleep and motionless.

- It is essential that all troops in a malarious area be trained and equipped to use mosquito bars.

-- The proper procedure is to tuck the mosquito netting under the mattress.

-- Then the soldier uses the aerosol bomb on the inside of the mosquito netting, killing any mosquitoes that may be under the net with him.

b. **Clothing.** When mosquitoes are prevalent, all personnel should wear loose-fitting clothing that will help protect them from mosquitoes when they are outside of screened enclosures.

- For this purpose, the uniform should consist of:

-- Long trousers.
-- Tuck trousers into boots.
-- Long sleeve shirts, buttoned at the neck, with sleeves rolled down.

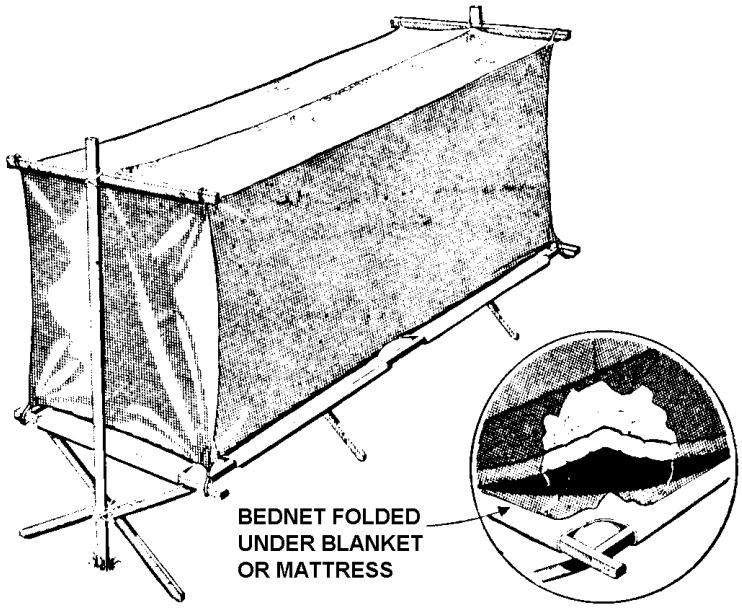


Figure 5-6. Mosquito bed-net on folding cot.

- In certain areas of the world, head nets may also be desirable.

- Mosquitoes can bite through clothing only when it is worn tightly against the skin.

c. **Chemical Repellents--DEET.** The issue insect repellent contains 33 percent DEET (diethyltoluamide) in a polymer cream. The repellent is effective against many biting insects including *Anopheles* mosquitoes. The repellents should be carefully applied over all exposed surfaces of the body except lips and eyes. Application should extend to about one-half inch above the cuffs of the sleeves. Application should be repeated every *4* to 6 hours.

d. **Chemical Repellents--Permethrin.** Permethrin is an insecticide that is used to impregnate fabrics including the BDU uniform, bed nets, tent screens, and the outer shells of sleeping bags. Permethrin has an extremely low toxicity for mammals including man, but is highly effective against biting insects. Thoroughly saturate the outer garments and allow them to dry thoroughly before wearing them. Permethrin should not be applied to inner garments (underwear, T-shirts, and so forth.) or to the inner lining of sleeping bags.

--CAUTION --
DO NOT wear flea collars to repel insects – not under any circumstances!!!

- Flea collars are NOT labeled for human use.
- Contact with the skin may cause severe chemical burns and absorption of toxic levels of insecticide through the skin.

e. **Avoidance of Unnecessary Exposure.** Highly malarious areas such as unprotected towns or villages should be avoided as much as possible. Swimming and bathing out-of-doors after sundown should be avoided in areas where there is a risk from malaria-carrying mosquitoes.

5-14. CHEMOPROPHYLAXIS

a. **Selecting Drugs to Prevent Malaria.** The selection of effective chemoprophylactic drugs for the prevention of malaria is becoming increasingly difficult because of drug resistant malaria parasites.

(1) Resistance. Since the early 1960s, the *P. falciparum* parasite has developed resistance to most of the drugs available for prophylactic use. The geographic distribution of this resistance and the level of resistance is changing rapidly. More and more countries are reporting resistance each year.

(2) Varied level of resistance. In those areas where the parasites are known to be resistant, the level of resistance varies. In some places, certain drugs are essentially useless. In other areas, an ever-increasing percentage of the parasites are not affected by the drug.

b. **The Drug of Choice.** Chloroquine remains the drug of choice for the prevention and treatment of malaria caused by *P. vivax, P. ovale,* or *P. malariae.*

- In some areas of the world, *P. falciparum* remains sensitive to chloroquine as well.

- When malaria is present in a region, usually more than one of the species is present.

- It is rare to find a region with only one species of malaria. Prophylaxis must be directed at the most resistant parasite that may be encountered.

c. **The Drug to Prevent *P. Falciparum.*** Since *P. falciparum* causes the most serious form of disease, it is our greatest concern and the primary objective of our

preventive measures. When a drug is selected to prevent the resistant forms of *P. falciparum,* that same drug will prevent malaria from the other species that could be encountered.

NOTE: It is not necessary to use one drug for *P. falciparum* and a different drug for the other species of malaria**.**

d. **Disease Control and Prevention Recommendations.** In general, the U.S. military has formally decided to follow recommendations of the Disease Control and Prevention (CDC, Atlanta, GA) concerning the choice of drugs for a particular area of the world. The CDC publishes a number of documents related to precautions for travelers and uses the publication entitled the "Weekly Morbidity and Mortality Report" (WMMR) to publish updates on this topic.

e. **The Final Decision on the Appropriate Drug.** The unit or installation medical officer should make the final decision regarding the appropriate suppressive drug for the area and type of deployment or travel.

- That decision should be based on many variables and made only after consultation with the Disease Control Consultant at the Office of the Surgeon General of the Army (OTSG).

- Medical authorities recommend appropriate actions.

Figure 5-7. Prevent mosquito-borne disease.

f. **Plan for Troops Exposed to Malaria.**

- While all four of the human malarias cause an acute illness, the disease caused by either *P. vivax* or *P. ovate* can relapse after treatment and recovery from the acute illness. Simple treatment of these forms of malaria will not prevent their return.

- Wherever troops are exposed to malaria, it is necessary that they receive a course of the drug primaquine to kill the liver stage of the parasite that may be present and may continue to develop and cause disease at a later date. The exact dose and timing of the course is determined by the responsible physician or Preventive Medicine personnel.

Section IV. ENVIRONMENTAL CONTROL OF THE MOSQUITO

5-15. ENVIRONMENTAL CONTROL MEASURES

Environmental control measures include:

- Proper selection of campsites.
- Mosquito-proofing.
- The destruction of adult mosquitoes.
- The control of mosquito breeding.

These measures, which have their greatest usefulness at permanent or semi permanent installations, may be applied in forward areas insofar as the military situation permits.

a. **The Element of Time in Preventive Measures.** From 4 to 6 weeks must elapse before measures to control mosquito breeding will materially reduce the hazard of malaria transmission. On the other hand, mosquito proofing and the destruction of adult mosquitoes are immediately effective in this respect.

b. **Know the Vectors and Their Habits.** Unless the vectors for each area and their habits are known, the problem of control cannot be undertaken with any degree of confidence.

- Swamp drainage would be of little value in controlling a vector which breeds in water collecting in parasitic plants that grow high in trees.

- The elimination of an anopheline that prefers feeding on animals other than man would have little effect on the incidence of malaria.

- House spraying with residual insecticides is apt not to be effective if the mosquito vector does not rest on the treated walls.

For these reasons it is important to seek the advice and services of personnel with adequate training in the field of medical entomology and malaria control.

5-16. SELECTION OF CAMP SITES

Since the effective flight range of *Anopheles* rarely exceeds 1 mile, sites should be located at least 1 mile from any known reservoir of malaria or from any large breeding area of anopheline mosquitoes, if the military situation permits.

5-17. MOSQUITO PROOFING

Mosquito proofing includes not only screening of doors and windows, but also closure of all other openings through which mosquitoes might gain entrance.

- In malarious areas, all buildings or tents where personnel eat, sleep, work, or congregate at night should be mosquito-proofed.

- For the protection of all concerned, patients undergoing treatment for mosquito-borne disease should be housed in mosquito-proof areas to prevent transmission of disease agents from patient to mosquito and from mosquito to patient.

- Routine maintenance of mosquito proofing is essential. Occupying units should make minor repairs as needed.

a. **Screening of Doors and Windows.**

- Screening against *Anopheles* mosquitoes, to be effective, must be 18 mesh or smaller.

-- The best grade metal or fiberglass screening available should be used.

- Window screening should be full length and securely fastened.
- Screen doors should open outward, be self-closing, and should be strongly constructed, so they will not sag or warp.

- In highly malarious areas, it is desirable to have double screen doors with a hall at least 6 feet in length between them.

b. **Closure of Other Openings.** Careful attention must be paid to the closing of all unscreened openings through which mosquitoes might gain entrance. All openings in screened buildings, such as cracks, knotholes, spaces in flooring, walls, or corner joints, should be closed with pieces of tin cans, shingles, or a mastic made by boiling shredded paper, flour, and water into a doughy mass and adding sand and cement.

c. **Tents.** In malarious areas, all tents except those used solely for storage should be equipped with insect screen liners. Application of permethrin to screen liners will increase their effectiveness.

5-18. DESTRUCTION OF ADULT MOSQUITOES

a. **Breaking the Cycle of Malaria Transmission.** One of the most effective means of promptly breaking the cycle of malaria transmission is the destruction of adult mosquitoes. This may be accomplished with:

- Residual sprays.
- Aerosol dispensers.
- Fog generators.
- Mist sprayers.
- Airplane spraying.

b. **Vectors with Physiological Resistance to Insecticides.** Some of the most important malaria vectors have shown physiological resistance to commonly used insecticides. In other cases, *Anopheles* vector species have developed behavior patterns that cause them to avoid lethal contact with residual insecticides. Where either of these problems seems to be interfering with control measures, the advice of medical entomologists should be obtained.

c. **Residual Sprays.** The application of an effective residual insecticide to the inside of buildings, tents, and other mosquito-frequented shelters is highly effective for killing adult mosquitoes.

(1) Application. The insecticide solution should be applied as a spray to walls, ceilings, screens, and other areas where mosquitoes rest. Special attention should be given to spraying the undersides and backs of furniture and the interiors of closets. Applications should thoroughly wet the surface but not run off.

(2) Treatment. In a malarious area, it may be advisable to treat all buildings in nearby towns and villages as well as buildings or tents in the military installation. Residual treatments, when carefully applied, are effective up to three months on surfaces protected from weather. However, to establish an effective application schedule, a qualified representative of the Army Medical Department should be consulted.

d. **Aerosol Dispensers.** A self-discharging, low pressure aerosol dispenser "bomb' (Figure 5-8) is very useful in treating all types of enclosures. Important points to remember include these:

- The aerosol does not provide any residual effect.
- Seven seconds' treatment with an aerosol bomb is adequate for 1,000 cubic feet of space.
- It should be carried through the area at a normal walking speed while the material is allowed to discharge upward toward the ceiling.
- Doors, windows, and vents should be closed during application and for at least 15 minutes thereafter.

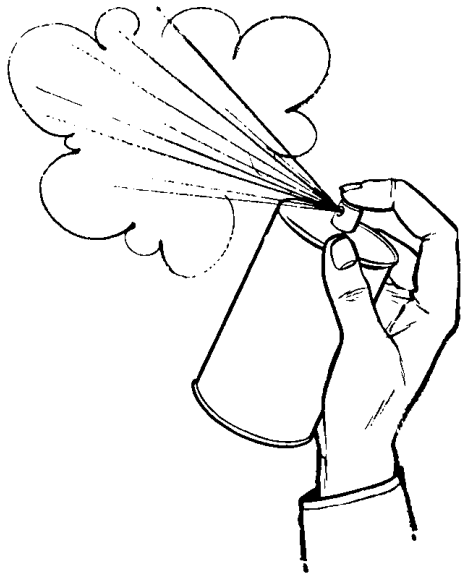


Figure 5-8. Aerosol bomb.

e. **Area Control.**

(1) Vegetation. Where the vector species utilize wooded resting places, area spraying of vegetation may be expected to contribute to areas, observation posts, gun emplacement, and so forth, by spraying vegetation with currently recommended residual effect insecticide in a strip surrounding the area to be protected.

(2) Area control with mist blowers or fog machines. Temporary relief from adult mosquitoes may be secured in open areas by the use of insecticides in the form of mist or wet heavy fog.

-- If fogging or misting is carried out on a regular schedule, a measurable freedom from adult mosquitoes may be maintained in an area which is also receiving good residual and larval treatment. Fogging or misting is not in any case a substitute for proper larviciding or residual spraying.

-- A special type of fogging is Ultra Low Volume (ULV) spraying in which small volumes of nearly concentrated (> 90 percent concentration) pesticide are applied as extremely small droplets.

-- To be effective, fogging or misting must be done during calm weather (wind under five miles per hour), at night or, preferably, early in the morning, in order to prevent too much dispersion of the insecticide by thermal updrafts.

5-19. CONTROL OF MOSQUITO BREEDING

Mosquito breeding may be eliminated or at least greatly reduced by such measures as:

- Drainage
- Filling
- Stream clearance
- Larviciding
- Elimination of artificial containers of water
- Fluctuation of the levels of impounded waters
- Removal of marginal vegetation
- Intermittent drying
- The introduction of certain species of fish into waters harboring mosquito eggs and larvae.

While larval control procedures provide the most effective long-term control of mosquitoes, they do not provide immediate control of adults, which may live up to six weeks. It is also important, therefore, to implement stringent personal protective measures and adult control measures when mosquito-borne diseases are present.

a. **Stream Clearance.** Control of mosquito breeding in marginal pools and collections of floatage in otherwise freely running streams and canals requires that stream margins be straightened and emergent vegetation cleared. Fill or drain marginal pools by connecting them with the main stream.

b. **Larviciding.** The decision to fill, drain, or larvicide waters used as breeding areas by mosquitoes depends entirely on local conditions, including permanency of the installation, cost of each type of control, and funds available. Mosquito breeding areas that cannot feasibly be filled or drained should be treated with larvicides to yield satisfactory control. Numerous pesticide formulations are labeled for use as mosquito larvacides.

c. **Sluicing.** In those areas where the anopheline vectors are stream breeders, they may be controlled by the use of siphon dams or lift gates by which water is impounded and then is periodically and suddenly released to flush away the larvae.

d. **Drying.** Where irrigation water in rice fields or canals is a source of mosquito breeding, effective control is sometimes possible by interrupting the supply of water so That the fields become just dry enough each week to remove the surface film of moisture without drying the roots of the plants.

e. **Water Level Fluctuation.** Periodic fluctuation of water level in ponds or reservoirs is sometimes very effective in controlling mosquito breeding by preventing growth of shoreline vegetation favorable to the larvae.

f. **Small Containers.** In some areas, routine attention must be given to artificial breeding places such as wells, cisterns, bottles, roof gutters, household water containers, metal cans, coconut shells, road ruts, and shell craters. These may be screened in, emptied, destroyed, or treated with a larvicide as indicated.

Section V. MOSQUITO-BORNE DISEASES - ARBOVIRUS DISEASES

5-20. GENERAL

a. **Definition.** Arboviruses (arthropod-borne viruses) are those viruses that are capable of infecting blood-sucking arthropods, proliferating in their tissues, and being transmitted from vertebrate to vertebrate by arthropods during feeding. The viral agents transmitted by arthropods now number more than 200, of which 80 are known to cause human disease.

b. **Basic Cycle of Arbovirus.** The perpetuation of an arbovirus in nature is dependent upon a basic (endemic) cycle involving a vertebrate host and an arthropod vector in intimate association. This basic cycle has been shown to exist for many arboviruses, but there are others that has not yet been demonstrated. The intimacy of the association between host and vector is emphasized because often the viremia (virus in the blood) is of a transient nature. Human infection is usually incidental to this basic cycle and is dependent upon the feeding habits of the vector.

c. **Transmission of Arbovirus.** Sandflies, ticks, and mosquitoes are the only families of blood-sucking arthropods have been clearly implicated as vectors of viral agents of disease. Of these, the mosquitoes transmit more than half the known viral pathogens. *Aedes* and *Culex* appear to be the most important genera of mosquitoes in the transmission of viral agents (Table 5-1).

d. **Arbovirus Diseases.** Yellow fever, the viral encephalitides, and the dengues are the best known of the viral diseases transmitted by arthropods. However, it is becoming increasingly evident that large segments of the world population have had experience with newly discovered and relatively poorly known viral agents, the clinical effects of which have been formerly diagnosed as “fever of unknown origin." Exotic names such as Kyasanur Forest disease, West Nile, and O’nyong-nyong give evidence of their wide geographical distribution. There is at least one arbovirus disease in virtually every country where we have military or political commitments.

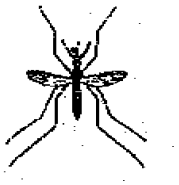
(1) Viremia. Clinical manifestations of a disease need not accompany viremia, and indeed there are many avian (bird) and mammalian hosts that are capable of supporting an intense viremia without clinical symptoms.

(2) Signs/symptoms. In most people who contract infection with one of the arboviruses, the disease is not clinically apparent. Only a small percentage of those

infected actually show symptoms. Those who experience infection, whether clinically apparent or not, develop a certain degree of immunity.

(3) The course of an epidemic. The course of an epidemic may be altered considerably by the development of antibodies in a group of people representing a large segment of the population. Thus, medical data concerning a particular country or area may not indicate the presence of an arbovirus disease. It may not reveal its real importance if it exists at a low level in the population because of a relatively immune population. When susceptible troops are introduced into such an area, however, the disease may wreak havoc among the newcomers.

5-21. YELLOW FEVER



Yellow fever is one of a group mosquito-borne, acute, hemorrhagic fevers of viral etiology.

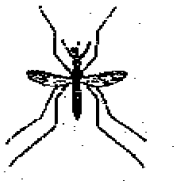
a. **Signs/Symptoms and Diagnosis.** Typically, there is sudden onset of headache, fever, vomiting, and prostration, and later jaundice and changes in blood composition. Internal hemorrhaging is evidenced by bloody spittle and passage of dark colored, pitch-like feces. Laboratory confirmation of the diagnosis includes isolation of the virus from the blood, demonstration of typical lesions of the liver, and other procedures.

b. **Prognosis.** While the fatality rate among natives of an endemic area is less than 5 percent, it may be as high as 40 percent among unvaccinated non-natives entering the area. The patient is infective for mosquito vectors shortly before onset of fever and for 3 days thereafter. The vector mosquito is infective for man some 9 to 12 days after taking a blood meal from an infected person and remains so for life. Typically, onset of fever in man occurs 3 to 6 days after inoculation by an infective mosquito. Recovery confers lasting immunity.

c. **Treatment.** There is no specific therapy for yellow fever. For the first 3 days of illness, patients should be cared for in areas that are screened against mosquitoes or have been treated with an effective residual insecticide.

d. **Method of Control.** The “man loving” *Aedes* mosquito vector can be controlled in urban areas by the methods outlined in paragraph 5-18. Attempts to control the jungle dwelling *Haemagogus* vector thus far have met with failure. Active immunization is very effective in the prevention of yellow fever.

5-22. DENGUE (BREAKBONE FEVER)



Dengue is a mosquito-borne virus that causes an acute, febrile infection of sudden onset, in sometimes-explosive epidemic proportions. Main areas of occurrence are shown in Table 5-1.

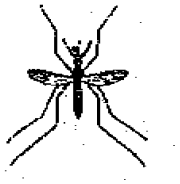
a. **Signs/Symptoms and Reservoir.** The fever lasts about 5 to 7 days, during which time there is intense headache, pain in the joints and muscles, and a rash. Fatal termination is rare. Humans are the only known vertebrate hosts for dengue and serve as the reservoir as well as definitive host.

b. **Period of Infection for Man and Mosquito.** Patients usually are infective for mosquitoes from the day prior to onset through the fifth day; accordingly, keeping patients in enclosures that are screened or treated with residual insecticide will reduce but not halt transmission to vector mosquitoes. The *Aedes* mosquito vector becomes infective for life 8 to 11 days after a blood meal from an infectious person. Incubation time from mosquito bite to onset of symptoms is 3 to 15 days, with 5 to 6 days the usual.

c. **Military Significance.** The military significance of dengue rests on its explosive nature, resulting in a high percentage of casualties in a short time, and in the prolonged convalescent period. There is no specific therapy. Recovery confers limited immunity.

d. **Prevention.** Prevention lies in control and avoidance of mosquito vectors.

5-23. THE ENCEPHALITIDES



a. **General.** The mosquito-borne viral encephalitides are acute inflammatory diseases of comparatively short duration that involve the central nervous system (CNS). These disease occur in widespread areas of the world and are not confined to the topics. The mosquito vectors considered most important in the transmission of these diseases to man are listed in Table 5-1.

b. **Natural Cycle of Infection and Diagnosis.** Most vectors seem to feed by choice on birds or small rodents. Hence, the primary natural cycle of infection probably is one of bird-mosquito-bird or rodent-mosquito-rodent, with the infection of man being only accidental. Each of these encephalitides is caused by a specific virus. Specific diagnosis is by serologic tests for which laboratories smaller than major overseas laboratories or area laboratories in the United States usually are not equipped.

c. **Prognosis.** The clinical syndrome produced in man varies with the severity of the infection and with the infecting agent. Murray Valley, St. Louis, and Western equine, with fatality rates approximately 5 percent, may be considered mild in comparison to Japanese B and Eastern equine, which have fatality rates ranging up to 60 percent.

- Death, when it terminates, one of these infections usually occurs in the first 7 to 10 days after onset of frank CNS signs.

d. **Signs/Symptoms.**

(1) Prodromal period. In the classical picture, viral encephalitis is often preceded by a 1- to 4-day prodromal period. During this stage, the patient usually complains of malaise, low-grade fever, headache, muscular pain, and sometimes symptoms suggesting a mild upper respiratory infection.

(2) Later symptoms. These early symptoms may, but usually do not, subside prior to:

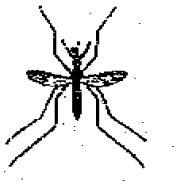
- Rather abrupt increase in fever (103°-105° F)
- Development of a much more severe headache
- Symptoms of CNS involvement including:
  - -- Marked rigidity of the neck and spine
  - -- Mental confusion
  - -- Disorientation
  - -- Delirium or coma
  - -- Generalized convulsions
  - -- Speech disturbances
  - -- Purposeless movements or tremors
  - -- Other signs and symptoms referable to the CNS

e. **Treatment.** The survivor of an attack, whether it is inapparent, mild, or severe, is immune to the specific agent causing the infection. There is no specific therapy for any of the arthropod-borne virus encephalitides.

f. **Prevention.** Vaccines, both formalinized mouse brain and chick embryo types, have had wide experimental use, but they are not, at present, generally available. Use of such vaccines requires special authorization of The Surgeon General. Prevention must be directed primarily at the effective control of the vectors or the safeguarding of the individual from bites of the vector by proper wearing of the uniform and use of repellents (para 5-13).

Section VI. MOSQUITO-BORNE DISEASES - FILARIASIS

5-24. GENERAL



Causative agents for filariasis are two species of nematodes (roundworms), *Wuchereria bancrofti* and *Brugia malayi.* The adult worms live in the lymph nodes and subcutaneous tissue of the human host reservoir, where they produce microfilariae, which find their way into the bloodstream and are picked up by a mosquito vector (Table 5-1) taking a blood meal. The microfilariae penetrate the gut wall of the mosquito, migrate to the thoracic muscles, and change into infective larvae that migrate to the

insect proboscis and are transferred to the human host. Little is known of the portion of the life cycle from larva to adult worm.

5-25. SIGNS/SYMPTOMS

The incubation period is long and the clinical course uncertain.

- Symptoms of infection may appear 3 months or longer after the transmitting mosquito bite, but microfilariae do not appear in the blood for at least 9 months.

- These early symptoms include fever and inflammation of the lymphatic system and genital structures.

- If not adequately treated, filariasis persists for years.

- Repeated or prolonged infections are manifested by lymphatic congestion and elephantiasis (an enlargement and thickening of the tissues), particularly of the lower limbs and the scrotum.

5-26. DIAGNOSIS/TREATMENT

Proof of diagnosis consists in demonstrating microfilariae or adult worms in certain tissues and organs and is difficult, especially in acute cases. Specific therapy consists of the use of diethylcarbamazine (Hetrazan, Banozide).

5-27. PREVENTION

In endemic areas, mass administration of diethylcarbamazine once per month produces a profound and prolonged reduction of microfilariae and thereby interrupts the transmission cycle. Nevertheless, measures directed toward the control of mosquito vectors afford the simplest approach (para 5-12), and any use of drug prophylaxis should be in conjunction with mosquito control measures.

Section VII. FLY–BORNE DISEASES

5-28. FILTH FLIES

a. **General.** Filth flies (that is, houseflies, blow flies, flesh flies) are two-winged flying insects found all over the world, but more abundantly in warmer climates. They are frequently found in kitchens and dining areas. Filth flies breed in filth, feed on it, and transmit it to man along with whatever pathogens may be in it. Typically, the common housefly, *Musca domestica,* goes through a 4-stage life cycle (Figure 5-9), which from egg to adult takes about 15 days.

- The adult female begins laying eggs in filth such as manure, garbage, rotting fruit or vegetables, and decaying organic matter after she is 48 hours old. During a lifetime of about 30 days, the female housefly lays an average of 1,000 eggs.

- Depending upon temperature and other conditions, the egg stage lasts from 5 to 36 hours.

- Newly hatched larvae (maggots) move about, feed on the surrounding organic matter, grow rapidly, and, after about 5 to 8 days, migrate to drier soil or stand to pupate.

- The pupal stage lasts from 4 to 7 days, and from it the fly emerges as a full-grown adult and crawls upward through the loose soil to the surface.

- Soon after, its wings dry and harden, and the fly is ready to start feeding.

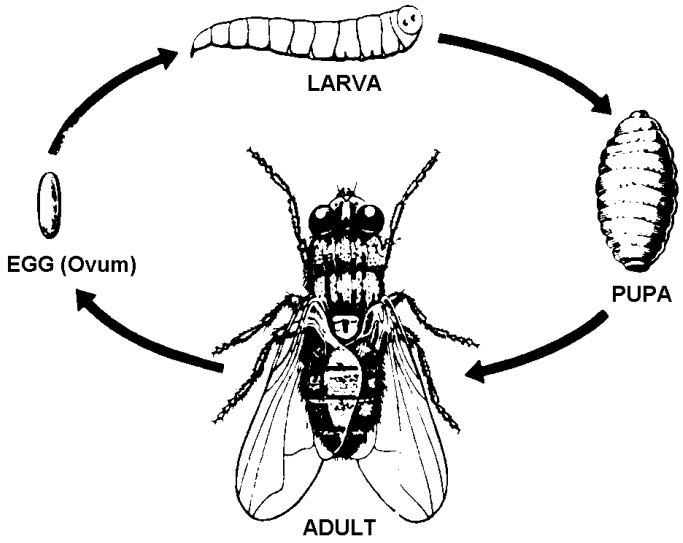


Figure 5-9. Life cycle of common housefly, *Musca domestica*.

b. **Fifth Flies As Disease Transmitters.** Filth flies have no biting mouth-parts and cannot take up solid food.

(1) Flies transporting pathogens. To dissolve solid food, the fly vomits onto the food, then sponges up the mixture, usually defecating in the process.

- The fly's proboscis and legs are covered with fine hairs to which bits of filth cling.

- The sticky substance on the fly's feet, which helps it to rest on walls and ceilings, also picks up bits of food.

- Thus the fly, as it buzzes indiscriminately from filth to human food or human skin, transports to man or his food whatever pathogens may be contained in the filth.

NOTE: Fly droppings (fly specks) left on human food may be little more than highly concentrated masses of organisms infectious to humans.

(2) Fly-spread diseases. The intestinal diseases, including the food poisoning pathogens (with the possible exception of botulism), are highly subject to transmission by flies.

- Shigellosis is an example of an important intestinal disease that may be mechanically transmitted by houseflies.

- Flies transmit:

  -- Respiratory diseases, particularly those transmissible by direct contact with a case.
  -- Respiratory discharges.
  -- Skin lesions.
  -- Moist fomites.

c. **Control of Filth Flies.** Flies may be controlled by eliminating their breeding areas; screening living quarters, kitchens, and dining areas; and by applying insecticides against adult flies. In the control of flies, a high level of general environmental sanitation is implied.

(1) Control of breeding places. To eliminate fly breeding places:

- All human waste, animal manure, and garbage must be covered, disposed of, or treated promptly and effectively.
- Field latrines and soakage pits should be constructed, used, maintained, and closed so as not to foster fly breeding.

- Fly breeding sites, which are identified, should be removed, and not sprayed with residual chemicals.

(2) Control of adult filth flies.

- The aerosol bomb may be used for quick knockdown and kill. When correctly applied, it is very effective.

  -- During application of the spray, windows and doors should be closed and remain closed for from 30 to 60 minutes after the application.

-- In dining facilities, application at the rate of 7 seconds per 1,000 cubic feet should be made from one-half to 1 hour before serving meals.

- Approved residual insecticides may be used for control of adult flies.

-- Residual sprays are effective for long periods of time.

-- Usually, from one-half to 4 hours exposure to spray residue is required to kill a filth fly.

-- The spray should be applied to areas where flies usually rest, such as ceilings, corners, table legs, windows, and other lighted areas.

-- These areas can be easily recognized by the presence of flyspecks.

- Swatting is an excellent way to kill flies that have entered a screened enclosure.

-- Dining and kitchen facilities should have several swatters conveniently placed.

-- Since flies seek lighted areas, the shades of most windows should be drawn.

-- The flies will then congregate near the light of the unshaded windows, where they can be easily swatted.

5-29. SANDFLIES

Sandflies are small, bloodsucking, hairy gnats which, to the casual onlooker, might look like small mosquitoes.

- Ordinary window screening that bars mosquitoes is ineffective against sandflies.

- These flies are annoying pests which inflict painful, irritating bites and are vectors for several communicable diseases.

- The sandflies make up a group of flies known as phlebotomine flies.

- Of particular military importance is *Phlebotomus papatasii.* the principal vector for sandfly fever.

a. **Sandfly Activity.** Sandflies are active at night, in the evening and at dawn; they usually avoid wind, sun, and full daylight, but they are attracted to artificial light.

They breed in dark places, caves, crevices, stone embankments, crumbling ruins, earth fissures, and stony rubble.

b. **Development.** Although the larvae require damp breeding media, too much moisture will kill them. The life cycle (Figure 5-10) usually takes several weeks to complete, varying considerably with environmental conditions. Adult flies travel in short, hopping flights from the breeding areas but rarely migrate farther than 50 meters.

c. **Sandfly Attack on Humans.** They attack man at the wrists, ankles, or any exposed part of the body, and they will readily bite through thin socks.

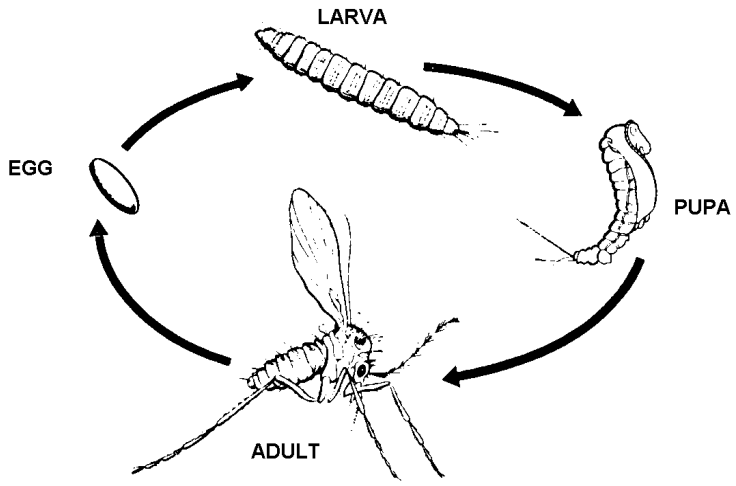


Figure 5-10. Life cycle of the sandfly (*Phlebotomus*).

5-30. SANDFLY FEVER

a. **General.** Sandfly fever is an acute, self-limiting disease of viral etiology that is transmitted through the bite of an infected phlebotomine fly. It occurs in tropical and subtropical areas of Europe, Africa, South America, and Asia. Epidemics are seen in non-native persons such as United States troops entering endemic areas.

(1) Reservoirs. Infected humans can infect flies 24 hours after becoming infected themselves. The flies become infectious to man 7 days after taking an infected blood meal and remain so for life. Man is therefore the reservoir, although the fly may also be, as there is some evidence of transovarian passage of the virus.

(2) Signs/symptoms.

- Three or 4 days after the infecting bite, symptoms appear that include fever, headache, malaise, and general pain in the limbs and back.

- Symptoms are alarming, but recovery is a virtual certainty.

- The fever, which lasts for 3 or 4 days, may exceed 104°F.

- Sandfly fever may recur, as one attack confers lasting immunity only to the specific type of virus causing the illness.

- There is no specific treatment.

b. **Prevention and Control.** Prevention of infection can be accomplished by the proper wearing of the uniform and application of repellents.

- Residual insecticides are effective against sandflies and should be applied to:

  -- Screens.

  -- Inside of buildings.

  -- Inside of sleeping quarters.

- Sandflies inside of sleeping quarters may also be controlled by use of a space spray such as pyrethrum.

- If possible, an area within a radius of 50 to 100 yards should be sprayed with a residual spray.

5-31. LEISHMANIASIS

Another group of diseases transmitted by phlebotomine sandflies is leishmaniasis. Leishmaniasis is infection by any of several species of flagellate protozoans in the genus *Leishmania.* Clinical leishmaniasis may be expressed in three forms: cutaneous, visceral, and mucocutaneous leishmaniasis.

a. **Cutaneous Leishmaniasis.** This form of the disease is characterized by nodular and ulcerating indolent lesions on exposed parts of the body. In parts of Africa and tropical America, lesions are more ulcerative and may involve mucous membranes, causing extensive necrosis of the nose, mouth, and pharynx. Secondary infection and complications may result in death.

(1) Primary locations. The disease is found primarily in India, Pakistan, the Middle East, Southern Russia, and Africa, in the Old World; and in Mexico, Central America, and South America in the New World. The infectious agents in the Old World include Leishmania tropica, L. major, and L. aethiopica. *Leishmania braziliensis* and *L. mexicana* are important agents in the New World.

(2) Reservoirs. The reservoirs are usually infected persons, dogs, cats, jackals, and gerbils. Most cases, in the absence of destructive complications, heal spontaneously and afford immunity against further infection.

b. **Mucocutaneous Leishmaniasis.** Chronic infections with *L. braziliensis* can also result in invasion of cartilage tissue. This form of the disease is known as mucocutaneous leishmaniasis. In severe infections, this may result in extensive destruction of these tissues, especially the cartilage of the nose, lips, and ears.

c. **Visceral Leishmaniasis (Kala Azar).**

(1) *Signs/symptoms.* This form of the disease is a chronic, systemic infection characterized by fever, enlargement of the spleen -and liver, lymphatic involvement, anemia, progressive emaciation, and weakness.

-- ATTENTION --
Untreated, the disease is highly fatal.

(2) Location. This disease occurs primarily in rural areas of most tropical and subtropical regions throughout the world. The epidemiology is similar to cutaneous Ieishmaniasis, except that the infectious agent is *Leishmania donovani.*

(3) Immunity. Recovery confers immunity; however, the cutaneous and visceral forms of the disease do not confer cross immunity.

(4) Control measures. There is no vaccine for artificial immunization; therefore, control measures are based upon protection from and destruction of sandflies.

5-32. AFRICAN TRYPANOSOMIASIS (AFRICAN SLEEPING SICKNESS)

African trypanosomiasis, also known as African sleeping sickness is a severe, highly fatal disease caused by infection with the flagellate protozoan *Trypanosoma brucei gambiense* or *T. b. rhodesiense,* transmitted through the bite of the tsetse fly *(Glossina sp.).* The disease is confined to tropical Africa, where the tsetse fly thrives.

a. **Reservoirs.** The primary reservoir for *T. b. gambiense* is man. The reservoir of the disease is a person with tryanosomes in his blood stream. Individuals may be asymptomatic carriers of the disease and clinical symptoms may be delayed 2 to 5 years. Wild game, especially antelope and bushbuck, and domestic cattle are also important animal reservoirs of *T. b. rhodesiense.*

b. **Signs/Symptoms.** In the early stages, the disease is characterized by fever, intense headache, insomnia, lymph node enlargement, anemia, edema, and rash. Later symptoms include wasting, drowsiness, and central nervous system signs.

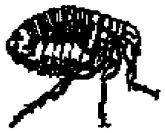
c. **Treatment.** Treatment consists of chemotherapy, which is effective if started before CNS involvement occurs. Natural immunity occurs in endemic areas, but there is no known vaccine.

d. **Prevention/Control.** Prevention and control are based upon elimination of the tsetse fly by wide clearings of brush around villages and along roads, streams, and other routes of communication. All possible fly-resting sites should be sprayed with residual insecticides.

Section VIII. FLEA-BORNE DISEASES

5-33. FLEAS

Fleas are small, wingless insects that feed voraciously on animals and man. They are well adapted for jumping, and, though measuring only a few millimeters in length, some can easily traverse a distance of 50 centimeters (about 20 inches) or more in one hop.



a. **Disease Vectors.** Several species are disease vectors, but the one of primary military importance is *Xenopsyl/a cheopis,* Oriental rat flea, which is the principal vector for plague and endemic (murine) typhus. Both the male and the female of this species are bloodsuckers. They tend to prefer the rat host but will readily leave a feverish or dead rat and seek a new host, attacking man readily.

b. **The 4-Stage Life Cycle of the Flea.** Fleas go through a 4-stage life cycle (Figure 5-11) that may require from a few days to over 200 to complete.

- After fertilization and a blood meal, the female lays eggs.
- The eggs develop into larvae which feed on flea excreta, debris found in the burrow, nest, or shelter of the host.
- The larvae then spin a cocoon, pupate, and emerge as adult fleas.

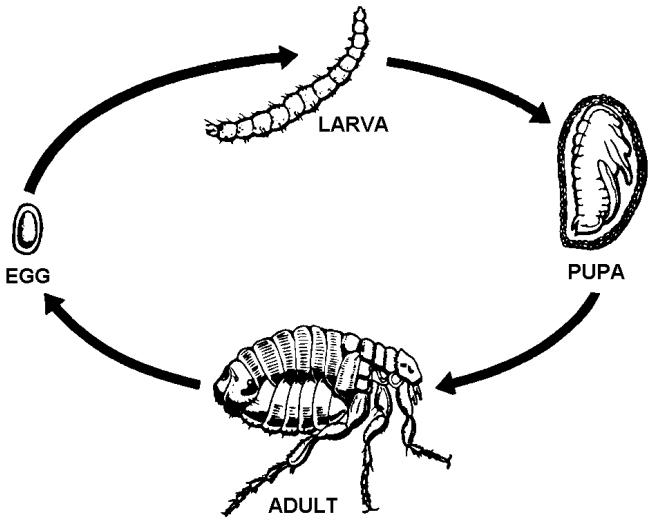


Figure 5-11. Typical life cycle of a flea.

5-34. RATS

a. **Wild and Urban Lifestyle.** Rats lead both a wild and an urban existence.

- They are particularly important among rodents as reservoirs for plague, endemic typhus, and other diseases communicable to man.

- Also, when living in close association with man, rats:

  -- Destroy subsistence and other supplies.

  -- Contaminate foodstuffs, damage buildings.

  -- Cause fire losses by gnawing insulation of electrical wires.

b. **Location.** Rats generally forage for food at night.

- Domestic rats prefer to travel close to buildings or walls,

- They have no aversion to entering and swimming in water.

- They will nest and proliferate in numerous places including:

  -- Double walls of buildings.
  -- Rubbish piles.
  -- Holds of ships.
  -- Burrows in the ground.
  -- Other places affording shelter, food, and water.

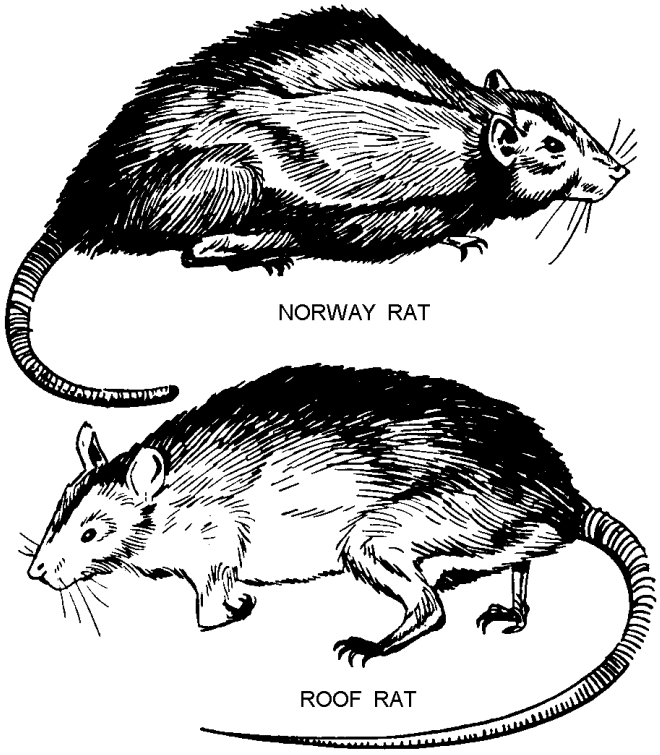


Figure 5-12. Two common domestic rats.

5-35. PLAGUE (BLACK DEATH)

a. **General.** Plague is a severe, acute infectious disease caused by the bacillus *Yersinia pestis.* It was known in the 14th century as the "Black Death,' which decimated the human population of Europe. Plague has four major clinical forms: bubonic, septicemic, pneumonic, and tonsillar septicemic. The latter two forms occur primarily during epidemics.

(1) Transmission. Transmission to man is usually by the bite of a rat flea and normally results in bubonic or septicemic plague. Either type of infection may progress into pneumonic plague. Droplets of sputum from patients with pneumonic plague, if inhaled, may result in primary pneumonic plague. Rarely, bubonic or septicemic plague may be contracted through minor skin abrasions when there is contact with infectious material.

(2) Locations. Plague is scattered widely, but unevenly, in endemic foci throughout India, China, USSR, Mongolia, parts of Southern Asia and the western United States. It has occurred in South Vietnam since 1962 in epidemic proportions.

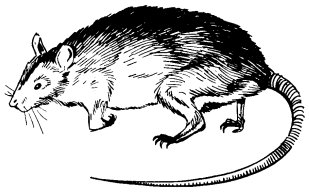
(3) Incubation period/treatment. The incubation period of all forms of the disease is usually six days or less, though rarely, incubation periods of 10 days have been reported. Once the most dreaded of diseases, plague today--if treated promptly and adequately--is a curable disease in all of its clinical forms.

b. **Bubonic Plague.** The primary characteristics of this form of plague is the enlargement of regional lymph nodes. It is generally caused by the bite of a rat flea *(Xenopsylla cheopis).*

(1) Sign/symptoms. Occasionally, a primary pustule or vesicle may develop at the site of the fleabite.

- In most cases, the first symptoms are fever and prostration coincident with lymph node enlargement (buboes).

- Buboes occur most commonly at the femoral or inguinal nodes, followed in order of frequency by auxiliary and cervical nodes.



- Buboes may be extremely painful.

- The infection may remain localized, may spread throughout the lymphatic system, or may develop into septicemia with pulmonary involvement (plague pneumonia).

(2) Prognosis. Without treatment, the overall case fatality rate for bubonic plague is about 30 percent.

c. **Primary Pneumonic Plague.** This form of the disease is generally caused by inhalation of plague organisms.

(1) Signs/symptoms. The typical case resembles lobar pneumonia clinically.

- Onset is abrupt, frequently with chills and high fever.

- Prostration develops rapidly.

- Sputum is produced near the end of the first 24-hour period.

(2) Prognosis. In the absence of treatment, the sputum increases in volume and becomes frothy and marked with bright blood.

- Sputum is literally loaded with plague bacilli.

- If not treated, the patient almost invariably dies within 2 to 5 days from the onset.

d. **Primary Septicemic Plague.** This form of plague may result from any route of primary infection.

(1) Signs/symptoms. This disease is an acute, usually fulminating disease in which a primary local lesion in lymph nodes or lungs is either absent or so minor as to escape recognition.

- The clinical picture is that of:

  -- Severe septicemia (chills, fever, and prostration).

  -- With extremely rapid deterioration of the patient's condition.

(2) Prognosis.

- Untreated cases result in death within 2 to 3 days of the onset.

- This form of the disease almost invariably appears in association with bubonic plague cases.

e. **Tonsillar Septicemic Plague.** This form of the disease is actually a subtype of bubonic plague contracted by inhalation of organisms rather than from a fleabite.

- It consists of a primary localization in the lymphoid tissue of the throat.

- The local involvement may or may not attain sufficient size to be evident clinically.

- The subsequent course may be that of either bubonic or primary septicemic plague.

f. **Diagnosis and Treatment.** When plague occurs in its classical epidemic form, the diagnosis is usually made on epidemiological and clinical grounds. Considerably more difficulty may be encountered when sporadic cases occur.

- Diagnosis is confirmed, using strict aseptic techniques, by demonstration of *Y. pestis* in bubo contents or sputum, or by inoculating laboratory animals with these materials.

- Treatment with antibiotics must be initiated immediately upon suspicion of plague diagnosis.

  -- The tetracyclines, chloramphenicol, and streptomycin are highly effective.

  -- The patient should be isolated and given bed rest with careful medical and nursing care.

g. **Prevention and Control Measures Applicable to the Source.**

(1) Isolation of patients.

- Patients should be kept in separate rooms (where possible) in a building devoted solely to the treatment of plague patients.

- All except necessary attendants should be excluded.

- Contact between suspects and manifest pneumonic cases must not be allowed.

- In pneumonic or suspected pneumonic cases, attendants must wear:

  -- Hoods with goggles or plastic eye openings.

  -- Coveralls or complete gown with trousers.

  -- Rubber gloves.

- All waste articles contaminated by discharges are to be incinerated.

- Used bedding and other fomites should be autoclaved or boiled.

- After a room is vacated, the walls, floor, and furniture should be disinfected by washing with a suitable potent disinfectant solution.

(2) Rodent control--sylvatic plague. Sylvatic plague is flea-borne plague among wild rodents caused by *Y. pestis.* It occurs as an epizootic (animal epidemic) disease not only among wild rats but also among ground squirrels, marmots, rabbits, and other rodents that do not ordinarily live in close association with man.

(3) Source of plague in humans. Plague may be the source of sporadic human infections and may be introduced into the domestic rat population of cities, and then, rat plague epizootics and human plague epidemics may occur.

- The rat population in endemic areas should be observed closely.

- Any increase in rodent plague should dictate the intensification of rodent control measures.

(4) Rodent control in the event of human plague.

- When human plague is discovered, the perimeter of the disease in the rodent population should be determined by trapping in every direction from the focus of human infection until no additional infected animals are found.

- Rat harborage destruction and rat proofing measures, as well as extermination programs, should begin at the suspected focus of rat infection, working outward in expanding circles, with emphasis on residual insecticides for prompt elimination of infected fleas, followed by rodent control measures.

NOTE: It is very important to eliminate the infected fleas before the instigation of rodent control measures**.**

(5) Control measures. The most effective method of rat control is by the reduction of food and water supplies available to the animals.

- For this reason, all possible efforts should be directed toward the proper handling and disposal of garbage.

- Supplemental rat extermination programs should be conducted by trained teams.

- Poisoning and fumigation are more effective than trapping for the destruction of large numbers of rodents.

- Nevertheless, where food is handled or stored, trapping alive is the method of choice, when compared to poisoning and fumigation, because of hazards created in using poisonous chemicals around food.

- Where access to water can be eliminated, the use of liquid anticoagulant formulations will prove more effective than baits.

h. **Prevention and Control Measures Applicable to the Vehicle.**

(1) Fleas. Elimination of fleas in and near buildings and inhabited areas is an integral part of the control program, and must precede rodent control measures, since fleas will leave a dead rodent in search of a living host.

- Rat harborages should receive special attention. Insecticides with long-term residual effect should be chosen if possible.
- Rodents should be trapped alive then chloroformed to kill both the rodent and ectoparasites.

- Appropriate dusts should be sprinkled around each bait station (when used) and in runways so that the rodent will get the insecticide on its' fur killing the ectoparasites on the rodent and in the nest to which the rodent returns.

(2) Contacts. Follow these guidelines:

- All contacts of plague patients should be dusted initially with a suitable insecticide and kept under surveillance for at least 6 days.

- International quarantine regulations require that contact of pneumonic plague patients must be quarantined for 6 days.

- If cases appear within such a group, the quarantine must be extended until 6 days have elapsed during which no new cases have appeared.

i. **Prevention and Control Measures Applicable to the Susceptible.**

(1) Immunization. Immunization is an important adjunct to a basic control program of improved sanitation aimed at reducing the rat and flea protection against human pneumonic plague.

(2) Specially treated clothing. In areas where plague is endemic, clothing must be treated with permethrin. All troops whose activities bring them into contact with ground that might harbor infected arthropods should have their blankets or sleeping bag covers impregnated with permethrin. This repellent is not to be applied directly to the skin.

(3) Repellents for skin application. Personnel in plague areas should treat exposed portions of the skin with DEFT insect repellent. In an emergency, individuals may apply the repellent to their clothing. Application to the uniform alone does not protect the exposed skin.

(4) Insecticide powder. Sleeping bags and bedding should be dusted with insecticide powder containing an appropriate insecticide.

(5) Avoidance of wild rodents. Contact with wild rodents should be avoided. Animals that appear to be "tame" are more likely to be sick than tame.

5-36. ENDEMIC TYPHUS

Endemic (murine) typhus is a flea-borne disease caused by *Rickettsia typhi* (sometimes referred to as *Rickettsia mooseri*).

a. **Clinical Picture.** Clinically, it resembles epidemic typhus (para 5-49a(1) through (5), but the course tends to be milder and the fatality rate tower. Diagnosis is confirmed by serological tests.

b. **Occurrence.** The disease is distributed wherever rats and people live in close association, as in the same building. In the United States, it is seen in Gulf and southern Atlantic coastal areas.

c. **Cycle of Infection.** A rat-flea-rat cycle of infection is maintained in nature. Domestic rats are the most important reservoirs, and the rat flea, *Xenopsylla cheopis,* the most common vector. The mode of transmission of the rickettsiae from flea to man

is through contamination of fleabite wounds or other skin abrasions with infective flea feces. The incubation period is from 6 to 14 days, with 12 the usual.

NOTE: Immunity conferred after attack is not always permanent**.**

d. **Treatment.** Specific therapy is the same as for epidemic typhus. Due to the efficacy of specific treatment and vector control, need for development of a vaccine is not considered critical. Use of the measures for the control of and protection from rodents and fleas markedly reduces the incidence of murine typhus in man.

Section IX. TICK-BORNE DISEASES

5-37. LYME DISEASE

a. **General.** Since it was first identified in 1982, Lyme disease has become the most commonly reported tick-borne disease in the United States. It occurs throughout the U.S. Most cases, however, are reported from three main foci. These are along the eastern seaboard from Massachusetts to Georgia; upper Midwest, mainly Wisconsin and Minnesota; and along the Pacific in Oregon and northern California. It also occurs in parts of Europe and Asia.

(1) Transmission. The causative agent is spirochete bacteria *Borrelia burgdorferi.* It is transmitted to humans through the bite of infected ticks.

(2) Vectors. Various species of ticks in the genus *Ixodes* are the primary vectors for Lyme disease. The role other tick genera play is not clearly understood.

- In the U.S., the black legged tick, *Ix. scapularis* is the primary vector in all but the Pacific Northwest.

- In California and Oregon, *Ix. paciflcus* is the primary vector.

Other *Ixodes spp.* serve as vectors elsewhere in the world.

(3) Reservoirs. The reservoirs for Lyme disease appear to be wild rodents and ungulates (hoofed mammals), especially deer.

b. **Etiology.** There appear to be three environmental requirements for Lyme disease to occur in an area. These are the presence of small rodents, large ungulate reservoirs, and *Ixodes* ticks. Rodents serve as hosts for tick larvae (newly hatched) and nymphs, and infect them with the Lyme spirochete. Adult ticks feed primarily on deer, but may feed on other large animals including humans.

c. **Symptoms.** Following the bite of an infected tick, a distinctive skin lesion called an erythema migrans (EM) develops within 5 to 10 days.

(1) Initial, acute phase. The EM lesion begins as a red macule or papule that expands in an annular manner, while clearing in the center. Lesions can expand to more than 30 centimeters; secondary lesions may develop. This initial, acute phase may be accompanied by general malaise, fever, fatigue, headache, joint stiffness, and other symptoms.

NOTE: These symptoms may precede EM lesion development and may last several weeks if left untreated**.**

(2) Later phase. A variety of neurological symptoms may follow within weeks to months after the onset of initial symptoms. These may include meningitis, encephalitis, and facial palsy. EM lesions are generally self-clearing after several weeks while other symptoms may subside or become chronic.

(3) Cryptic phase. The bacteria typically then goes into a cryptic phase, followed by latent chronic swelling and arthritis of the large joints a few weeks to several years after the initial infection.

d. **Treatment.** Lyme disease generally responds well to antibiotics, especially tetracycline and doxycycline, in its early acute stage. Lyme disease is extremely difficult, however, to treat in chronic stages, and may require lengthy intravenous antibiotic therapy. There are currently vaccine trials underway in the U.S. to prevent infection. Personal protective measures should be taken to prevent tick bites.

5-38. ROCKY MOUNTAIN SPOTTED FEVER

a. **General.** This tick-borne disease is seen not only throughout the United States, where it is currently most prevalent in the Southeastern and Middle Atlantic seaboard states, but also in other countries of the Western Hemisphere.

(1) Transmission. The causative agent, *Rickettsia rickets/i,* is ordinarily transmitted to man by the bite of an infected hard tick, of which a number of genera are involved. Transmission can also occur through contamination of the host skin with tick feces or tissue from crushed ticks. Ticks become infected for life by feeding on infected rodents, dogs, or humans, and they pass on the infection to progeny that hatch from infected eggs (transovarian transmission).

(2) Symptoms. Symptoms in humans appear about 3 to 10 days after transmission of the rickettsiae. Rocky Mountain spotted fever (RMSF) is an acute infection of the innermost wall of the blood vessels, characterized by:

- Sudden onset of fever
- Headache

- Other symptoms
- Usually a rash on about the third day

(3) Without treatment. In the absence of specific therapy, the fatality rate is about 20 percent. Death is uncommon with prompt and adequate treatment.

b. **Specific Therapy.** Therapy consists of daily administration of tetracycline antibiotics or chloramphenicol orally until the fever subsides, then continuing the drug for an additional day or two. All ticks on the patient's body must be removed and destroyed.

5-39. PREVENTION

Normally, the larva, nymph, or adult vector of RMSF (Figure 5-13) crawls up on tall grass or other vegetation and attaches itself to the fur of an animal or clothing of one who brushes by.

a. **Tick Activity.** Within about two hours, often without the host being aware, the tick attaches itself to the skin and takes a prolonged bloodmeal.

- These ticks are extremely hardy and may survive in each stage for more than a year without obtaining a blood meal.

- In hot summer months, the adults may undergo a period of inactivity.

b. **Preventive Measures.**

- Accordingly, large-scale measures directed against tick populations generally are of little value.

- Prevention of RMSF should be based chiefly on avoidance of tick-infested areas or the use of personal protection measures when avoidance is not possible.

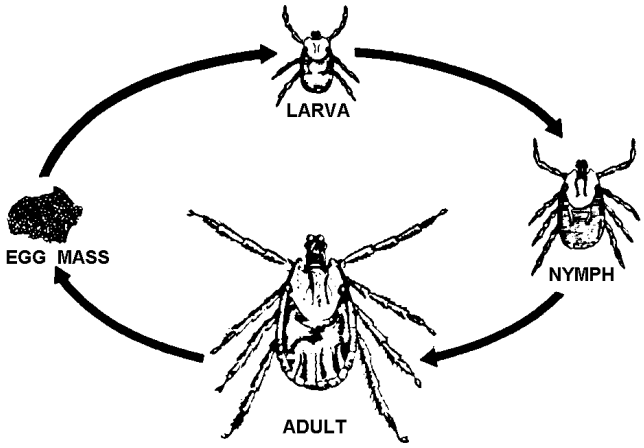


Figure 5-13. Life cycle of the hard tick.

5-40. PERSONAL PROTECTION MEASURES

a. **Avoidance and Removal.** There is evidence that infected ticks do not usually transmit RMSF until after they have teen on the host at least 4 to 6 hours. Thus if persons in tick-infested areas examine their bodies frequently, and remove ticks before they have been attached to the skin for as long as 4 hours, this will usually preclude contracting the disease.

(1) Tick attached to the skin. When removing a tick attached to the skin, one should take care not to crush it or leave the mouthparts imbedded in the skin. Crushing the tick may contaminate the fingers and facilitate transmission of the rickettsiae.

(2) The removal process. Remove the tick by first relaxing it, then carefully pulling it out with small forceps, grasping the tick as close to the mouthparts as possible.

Relax the tick by covering it for a minute or so with an alcohol-saturated tissue or cloth.

- Nail polish remover or liquid insect repellent has also been used with good results.

- Relaxing the tick will cause it to withdraw its mouthparts at least partially, facilitating its removal with a minimum of complications, or pain to the host.

-- CAUTION --

Avoid relaxing a tick with flame or heat, as this may directly injure the host, as well as cause the tick to regurgitate rickettsiae into the host.

- After removal, destroy ticks by burning and treat bite wounds with a suitable antiseptic.

b. **Proper Wearing of the Uniform.** When in tick-infested areas, personnel should tuck their trousers snugly into their boots, roll their sleeves down, and button their collars.

c. **Treating the Uniform with Repellent.** The uniform should be *treated* with repellent, known as clothing impregnant.

- Impregnated clothing may protect the wearer from attack of ticks or chigger mites for 4 to 6 weeks if the garment is not laundered.

- In RMSF endemic areas, the garment should be reimpregnated after every laundering.

  -- This can be done either at unit level or at the laundry facility.

- In addition to wearing a treated garment, repellent should be applied to exposed skin surfaces.

d. **Applying Repellent to Clothing.** If treated clothing is unavailable, also apply insect repellent to clothing in these areas:

- As a moist band 1/2 inch wide on the inside of the trouser bottoms.

- At the top of the boots.

- Inside the waistband, the collar, and the sleeve cuffs.

- Between the buttoned surfaces of the shirt fron.t

5-41. UNIT CONTROL MEASURES

As the military situation warrants, unit field sanitation teams may clear vegetation from the unit area, destroy or otherwise reduce dog and other small animal populations, and apply appropriate insecticides as recommended by the command entomologists or preventive medicine officer.

5-42. RUSSIAN SPRING-SUMMER ENCEPHALITIS

This disease belongs to the group of viral encephalitides previously discussed.

a. **Transmission.** Epidemiologically, it differs from them in that it is transmitted by a hard tick (genus *Ixodes)* rather than a mosquito. Humans are infected accidentally in the rodent-tick-rodent cycle of infection.

- The tick, which apparently is the true reservoir, remains infective for life and passes the virus to progeny by transovarian passage.

- The disease is widespread throughout much of Eastern Europe and Siberia.

- One attack confers immunity.

b. **Transmission/Prevention.** There is no specific treatment. Prevention is the same as for other tick-borne diseases.

5-43. COLORADO TICK FEVER

Colorado tick fever is an acute febrile, tick-borne viral disease similar to dengue. It is usually a mild disease, deaths being uncommon. It is found throughout the western U.S., especially at high altitudes.

a. **Reservoir/Vector.** Small mammals, particular ground squirrels, chipmunks, and porcupines, serve as the reservoir, and it is vectored by the wood tick *(Dermacentor andersoni), a* hard tick.

b. **Treatment/Prevention.** There is no specific treatment or immunization for the disease. Prevention is the same as for other tick-borne diseases.

5-44. TICK-BORNE VIRAL HEMORRHAGIC FEVERS

Several viral hemorrhagic fevers are transmitted by means of tick vectors.

a. **Signs/Symptoms.** The hemorrhagic fevers are characterized by:

- Headache.
- Fever.
- Severe pain in the limbs and lower back.
- Sometimes--vomiting, abdominal pain, and diarrhea.

NOTE: Severe cases are associated with bleeding from the gums, nose, lungs, uterus, and gastrointestinal tract**.**

b. **Diagnosis/Control Measures.** Specific diagnosis is by isolation of the virus from blood. Control measures are the same as for Rocky Mountain spotted fever.

Section X. MITE-BORNE DISEASES

5-45. MITES

Mites are tiny members of the class *Arachnida* barely visible to the naked eye. Two genera of mites, *Trombicula* and *Sarcoptes,* are of military medical importance.

a. **Trombicula.** The various species of *Trombicula* are found worldwide. The larvae (chiggers, or "red bugs") attack the skin of humans and cause an itching dermatitis of varying severity.

- The larva of *Trombicula akamushi* is the principal vector for scrub typhus.

- *T. akamushi* abounds mainly in the scrub and brush of Asia and the Southwest Pacific islands.

- The species of *Trombicula* found in the U.S. are not known to transmit disease, but the larvae feed on man and frequently cause great annoyance to some individuals.

Nymphs and adults of trombiculid mites feed on insect eggs and immatures of insects and other arthropods.

b. **Sarcoptes.** These mange, itch, or scabies mites are distributed worldwide. Of particular importance is *Sarcoptes scabiei,* the etiologic agent for human scabies.

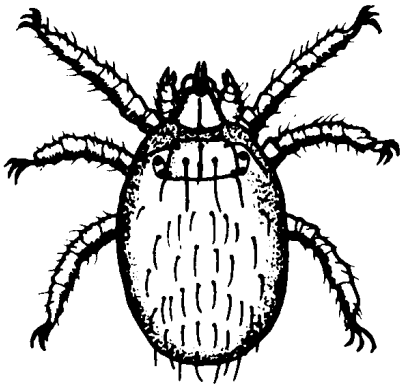


Figure 5-14. *Trombicula* mite larva.

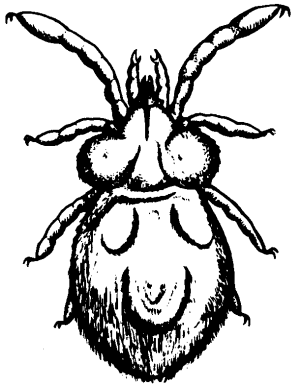


Figure 5-15. Freeliving adult mite.

5-46. SCRUB TYPHUS

a. **General.** Scrub typhus (mite-borne typhus, tsutsugamushi disease) is a febrile infectious disease caused by *Rickettsia tsutsugamushi* and is transmitted to man by the bite of infected larvae of Trombiculid mites.

b. **Signs/Symptoms.**

(1) Clinical course. The clinical course resembles that of other typhus-like disease.

- A primary lesion (eschar) occurs at the site of attachment of the mite 4 or 5 days after attachment.

- Onset of the acute febrile stage is from 6 to 21 days, usually 10 to 12, after attachment of the chigger.

- In the absence of specific therapy, fever persists for about 2 weeks.

(2) Immunity.

- In the general population, from 1 % to 40% of untreated cases terminate fatally.

- Scrub typhus can recur in the same individual, since one attack confers long-term immunity only to the specific strain of *R. tsutsugamushi* that caused the initial attack.

Figure 5-16. The transmission cycle of scrub typhus in nature.

c. **Military Importance.** While susceptibility is general, epidemics occur when non-native susceptibles such as United States troops are brought into endemic areas. Scrub typhus assumed military importance when it was encountered during World War II operations in the Southwest Pacific area and in the China-Burma-India Theater among both Allied and Japanese Forces.

d. **Transmission.** The infection is maintained in a mite-to-mite cycle through transovarian infection of progeny, and in a mite-to-mite-wild rodent-mite cycle. Both mites and rodents are reservoirs for the disease.

e. **Treatment.** A tetracycline antibiotic or chloramphenicol orally in divided doses usually will render the patient afebrile in about 30 hours.

f. **Prevention.** Vaccines for use in immunization of personnel against scrub typhus have not proven satisfactory. Area control of mites is difficult and in many cases not practical. These guidelines may be followed:

- The number of mites in a particular area may be reduced to some extent by the use of appropriate insecticides.

- In permanent or semi permanent camps located in areas where scrub typhus is prevalent, remove all surrounding growth with bulldozers, burn the collected debris, and place tents 2 or 3 feet off the ground.

- Control of rodents is helpful.

- Avoid mite-infested areas, if possible.

- If these areas cannot be avoided, personnel should wear the uniform and the insect repellents.

5-47. SCABIES

a. **General.** Scabies is an infection caused by the entrance and multiplication of the scabies mite, *S. scabiei*, in the skin of the host. Man is the reservoir. Scabies, like typhus, is a disease that accompanies wars or other conditions where it is hard to keen clean.

b. **Transmission.** The mites are transmitted by direct contact with infested individuals or with undergarments or other objects contaminated by them. Adult mites are most usually found in skin folds, such as webs of the fingers and skin of the external genitalia, but they will attack any skin area.

c. **Development.** The female burrows into the skin and deposits eggs in the burrow. Larvae hatch out in about 4 or 5 days and roam freely over the skin. Within a few days, the nymph--then the adult--stages are reached, and the fertilized females burrow into the skin to lay eggs and remain probably throughout their lifetimes.

d. **Signs/Symptoms.** At first, the host may be unaware of the presence of the mites, but soon he notices intense itching, which may be so severe as to preclude sleep. Scratching facilitates spread of the disease and frequently causes secondary infection.

NOTE: Infection is maintained in mites and rodents, with man an incidental intruder into the cycle.

e. **Specific Therapy.** Scabies mites in the skin can be killed by applying, twice a day until all mites are killed, lindane ointment, 0.5 to 1percent, preferably after a warm bath. Fresh clothing and bedding should be acquired. Ordinary laundering and dry cleaning will destroy mites in clothing.

f. **Prevention.** Prevention obviously rests in the practice of good personal cleanliness, with emphasis on frequent hand washing with soap, bathing, and avoidance of close contact with potentially infested persons, such as refugees, displaced persons, war area indigenous personnel, and promiscuous sex partners.

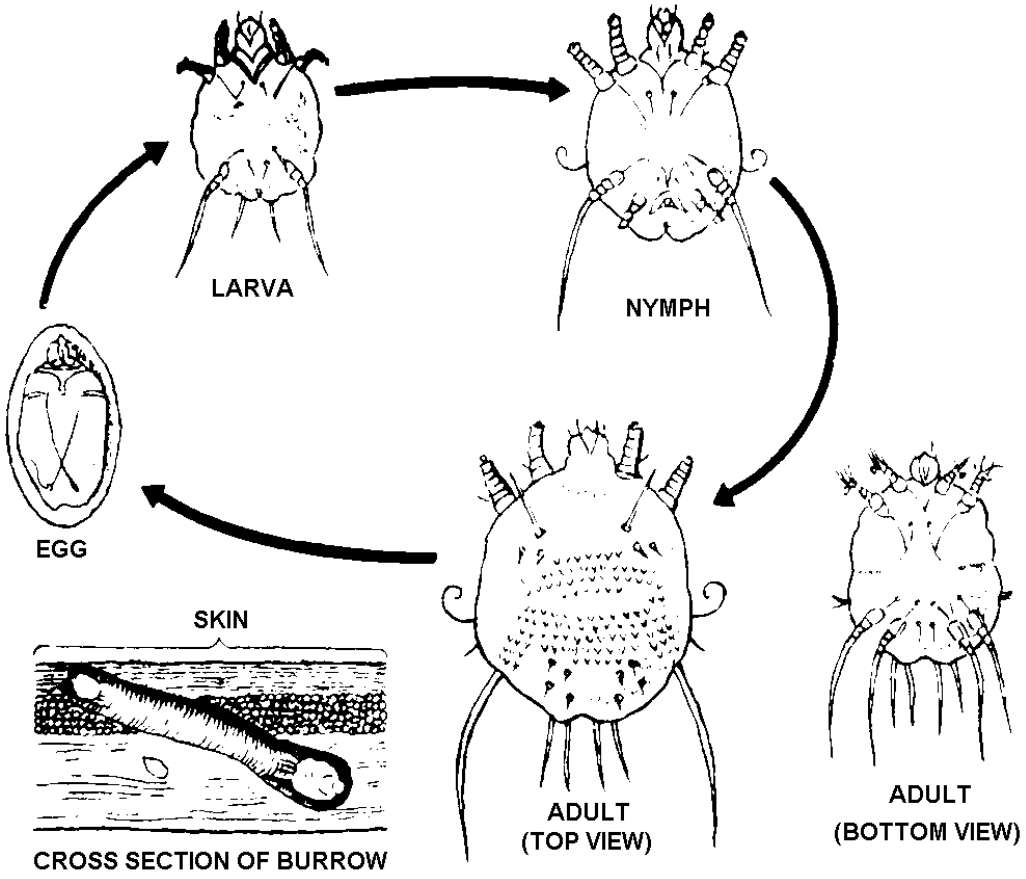
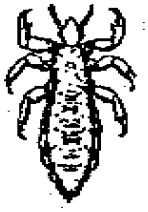


Figure 5-17. Life cycle of scabies mite.

Section XI. LOUSE-BORNE DISEASES

5-48. LICE



Louse-borne diseases have always been a threat to fighting forces. Lice are particularly associated with cold weather, and, while they are also present in the higher altitudes of the tropics, they are found more commonly in temperate and subarctic areas where clothing is heavy and is worn in several layers. Three species of lice are of medical importance: the body louse, the head louse, and the crab louse. All go through the life cycle depicted in Figure 5-18.

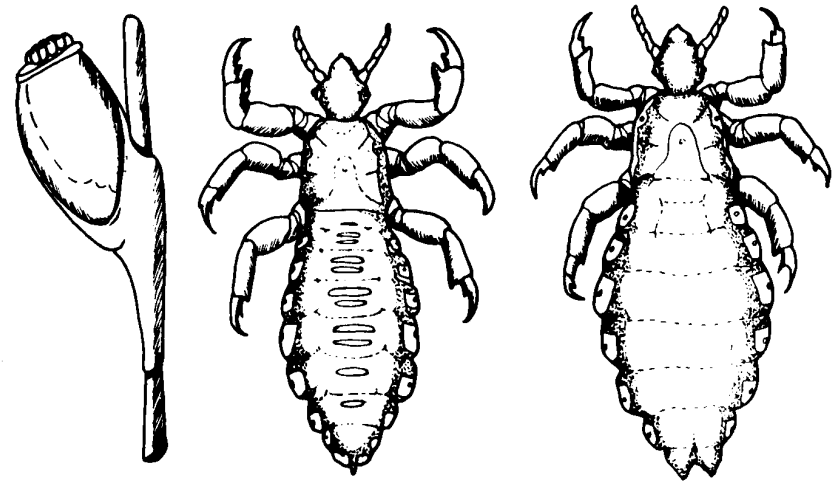


Figure 5-18. Life cycle of lice (*Pediculus humanus corporis*).

a. **The Body Louse.** The body louse *(Pediculus humanus)* is the vector of epidemic (louse-borne) typhus and epidemic relapsing fever.

(1) Nits. The body louse attaches its eggs to the fibers of clothing, especially along the seams, and rarely to body hairs. The eggs (nits) are white in color, oval in shape, have a lid on one end, and are about the size of the period at the end of a sentence. At temperatures of from 86° to 90° F, eggs will hatch into nymphs in about 8 days; but at lower temperatures the hatching process may take 2 weeks or more.

(2) Nymphs. Nymphs are similar to the adult, except that they are much smaller (pinhead size). Unless they obtain a meal of blood within 24 to 48 hours after hatching, the nymphs will die. The nymphal stage lasts about 9 days, after which the louse is a mature adult.

(3) Adult louse. Adult females begin to lay eggs 4 days after maturity, at the rate of from 5 to 10 eggs a day. Under favorable conditions, they will continue the

laying process for 30 days. Except when taking blood meals, the adult louse remains in the person's clothing.

b. **The Head Louse.** The head louse *(Pediculus humanus capitis)* closely resembles the body louse but unlike the body louse, is unimportant as a vector of disease.

- This pest is generally confined to the human scalp and head hair.

- The female cements her eggs to the hair, especially in the area above and behind the ears and towards the nape of the neck.

- The life cycle is similar to that described above for the body louse, although the head louse tends to be smaller and lays fewer eggs, and generally remains on the host throughout the life cycle.

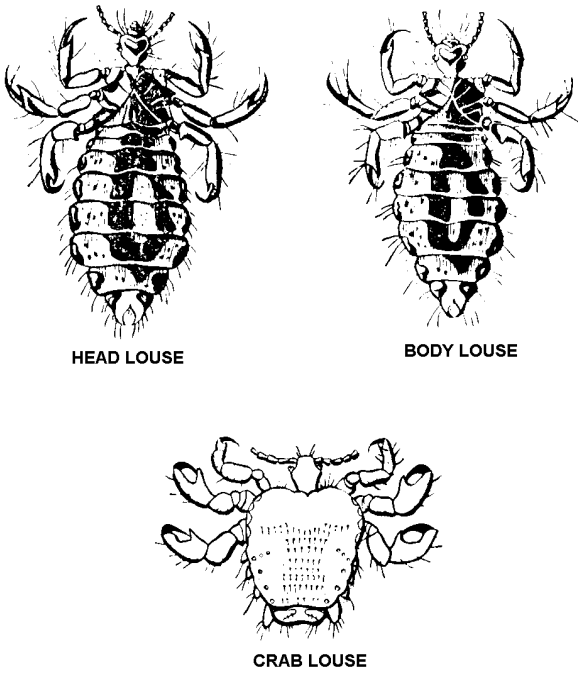


Figure 5-19. Lice of medical importance.

c. **The Crab Louse.** The crab louse *(Phthirus pubis),* readily recognized by its crab-like appearance, is probably of no importance in disease transmission, but it is of military importance as an annoying pest and as an indicator of the state of personal hygiene in a unit.

- Crab lice frequently are acquired during sexual contact with an infested individual.

- The parasite infests the armpits, beard, eyebrows, eyelashes, and particularly the pubic region, where it takes blood meals; females attach eggs to hairs.

- The incubation period requires from 7 to 10 days. Nymphs reach the adult stage in about 15 days.

5-49. EPIDEMIC TYPHUS AND RELAPSING FEVER

a. **Epidemic Typhus**

(1) First week. While the onset of this louse-borne disease is variable, typically the 6- to 15-day incubation period is followed by sudden onset of chills, headache, general pains, and malaise. Fever, which is low during the early part of the first week, rises steadily and rapidly and is accompanied by excruciating headaches. A rash occurs on about the fifth or sixth day.

(2) Second week. During the second week, fever remains elevated and the patient becomes desperately ill.

(3) Third week. Recovery may occur in the third week, otherwise death from urea in the blood, pneumonia, circulatory collapse, or some other immediate cause may occur. In epidemics, from 10 percent to 40 percent• of the cases terminate fatally in the absence of specific therapy.

(4) Transmission. Transmission of the etiologic agent, *Rickettsia prowazekii,* seldom occurs through the actual bite of the louse. Instead, scratching of the itching louse bites has the effect of rubbing rickettsiae-laden louse feces or juices from crushed lice into the bite wounds or other skin abrasions.

(5) Immunity/recurrence. One attack usually confers lasting immunity to reinfection; however, a recurrence (Brill's disease) may occur several years after the primary attack and in the absence of lousiness. The recurrence is not so severe as the primary attack, but the patients are infective to lice and may serve as the foci of new outbreaks of epidemic typhus in susceptible, louse-infected populations. Tetracycline antibiotics or chloramphenicol usually renders the patient afebrile.

b. **Epidemic Relapsing Fever.** This disease occurs in limited localities in Asia, Eastern Africa, North and Central Africa, and South America. Epidemics are common in wars, during famines, or wherever malnourished, overcrowded populations with poor personal hygiene and the body louse coincide. Causative agent of the disease is the spirochete, *Borellia recurrentis.*

(1) Signs/symptoms. Incubation period of this disease is 3 to 10 days. The patient experiences:

- Sudden onset of high fever.
- Chills.
- Headache.
- Generalized pains.
- The fever subsides after about 4 days, rises again in 3 to 10 days, followed by one or more relapses.
- Mortality is generally low, but may reach 50% or higher in crowded, poverty-stricken, and louse-ridden populations.

(2) Transmission. Transmission of the disease from louse to man is similar to that described above for epidemic typhus.

(3) Immunity/treatment. Duration of immunity after clinical attack is unknown, but probably less than 2 years. Tetracyclines are the specific treatment indicated.

5-50. PREVENTION AND CONTROL OF LOUSE INFESTATIONS

a. **General.**

(1) Identification/transmission**.**
Louse infestation (pediculosis) is a morbid condition transmissible from human to human and through direct contact with:

- Infested persons
- Their clothing, towels, and bedding
- Latrines used by them

(2) Importance to the military. In addition to the louse-borne diseases which may be transmitted and the discomfort occasioned by louse bites and consequent scratching and irritation, pediculosis:

- Causes a general feeling of fatigue and irritability that reduces efficiency and lowers morale.
- Constitutes a health hazard.

b. **Troops in Civilian Louse-Infested Areas.** When troops are stationed in areas where the civilian population is lousy, chances are high that the troops will become infested. Follow these guidelines:

- Inspect the troops frequently for lice.

- Control by emphasizing good personal hygiene among the troops.

- Provide adequate laundry facilities.

NOTE: Laundering clothing at 140°F or higher (and dry cleaning) will kill all active lice as well as their eggs.

- Whenever a person's skin shows evidence of scratching or of insect bites, he should carefully examine his clothes for body lice, particularly at the seams where they tend to congregate.

- When one infested person is found, all other personnel in his unit should be carefully examined for lice.

-- If 5 percent or more of the personnel in a unit is found to be infested, the entire unit should be deloused using mass delousing procedures.

-- If less than 5 percent is found to be infested, the infested personnel should be treated using individual delousing procedures.

-- Weekly inspections should be made by the medical officer in either case to determine efficacy of the operation.

- In areas where the native inhabitants are known to be louse-infested, personnel should avoid having intimate relationships with them.

c. **Individual Delousing.**

(1) Body louse. Good personal hygiene, regular changing of clothes, and effective laundry procedures cannot be over-stressed in controlling this louse.

- Personal hygiene, however, is of little value in the absence of effective clothing treatment.

- In addition to regular laundering, uniforms should be impregnated with permethrin.

- A few lice may be harbored in bedding, extra clothing, and miscellaneous articles such as canvas packs, duffle bags, boxes, and footlockers.

- Where possible, treat these with effective laundry.

- Otherwise, treat fabrics with permethrin and use an aerosol bomb to treat impervious surfaces.

NOTE: The US Army no longer has mass delousing capability with louse powders. There is no longer an effective pesticide labeled for this use, and the necessary dispersal equipment is no longer in the inventory**.**

(2) Head louse and crab louse.

- Effective insecticidal shampoos and ointments are available by prescription for control of these pests, and should be used as directed.

- When these are not available, the louse powder can be used, although to be effective it must remain on the body at least 10 days, as it does not kill the eggs.
- Thoroughly treat the body areas affected.

- Treat clothing and bedding preferably by effective laundering, or if this is not possible, then with permethrin or aerosol bomb, as appropriate

d. **Mass Delousing.** Mass delousing procedures are quite likely to be the method of choice in delousing large numbers of people such as would be found in:

- Prisoner-of-war camps.
- Displaced person camps.
- Occupied cities.
- Ports of embarkation and debarkation.

-- ATTENTION --

When typhus occurs in civilian communities under military jurisdiction, the military commander should immediately assume responsibility for the institution of appropriate control measures. Mass delousing should be accomplished as soon as possible.

(1) Hand dusters.

- When hand dusters are used, formation of delousing teams of 3 to 5 enlisted men, with a noncommissioned officer to direct the operation, has proven effective.

- At least two even strokes of the plunger of the hand duster held in each of the positions will deliver a total of about two ounces of louse powder to each individual being dusted.

- In this manner, the delousing teams can disinfest from 150 to 250 persons per hour.

(2) Power dusters. Gasoline engine driven delousing outfits may be used to dust 600 or more persons per hour by momentarily releasing the trigger of the dust gun held in the same positions as the hand duster.

Continue with Exercises

EXERCISES, LESSON 5

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. American soldiers deployed to regions of the world in which disease-carrying arthropods flourish may become ill while a native of the area may remain disease-free. What is the reason?

2. In transmission of a disease agent, the agent spends a portion of its life cycle within the body of an intermediate host. This is the _____ method of disease transmission.

3. An arthropod travels from a manure pile to an outdoor latrine. The arthropod continues traveling to an area containing eating utensils. In this area, the arthropod deposits infectious organisms. This is termed _____disease transmission.

4. The most important group of arthropod disease vectors are _____.

5. The causative agent of malaria is a mosquito-borne:

   a. Virus
   b. Bacillus
   c. Rickettsia
   d. Protozoan

6. Malaria can be transmitted from person to person by:

   a. Very close contact, such as sleeping together
   b. Indirect contact (formites, eating utensils, etc.)
   c. Sexual contact
   d. Transfusion of infected blood

7. The type of malaria a person develops is dependent upon:

    a. The species of Plasmodium with which the mosquito is infected
    b. The species of mosquito which bites the individual
    c. The sex of the mosquito
    d. Whether the individual takes chemical prophylaxis

8. Can flea collars be worn by soldiers to repel insects? Why?

9. Prevention of dengue fever is of military important because of this disease:

    a. Causes _____
_____.

    b. Results in _____
_____.

10. Answer the following statements TRUE or FALSE.

    a. Active immunization against yellow fever is very effective. _____

    b. There is no specific therapy for yellow fever. _____

    c. Recover from yellow fever confers immunity for only a few months. _____

11. Viral diseases transmitted by mosquitoes include:

    a. Malaria
    b. Yellow fever
    c. Dengue
    d. Encephalitides
    e. Filariasis

12. What is a disadvantage of using larvaciding as a method of mosquito control?

13. Mosquito-borne viral encephalitides diseases are _____ _____.

14. Filariasis differs from other mosquito-borne diseases in that the causative agent is a:

a. Spirochete
b. Nematode
c. Fungus
d. Tapeworm

15. Houseflies transmit the intestinal disease _____ plus some food poisoning pathogens.

16. The complete life cycle of the housefly requires about _____ days to complete.

17. Sandfly fever is transmitted through the bite of an _____.

18. Two reservoirs for sandfly fever are:

a. _____

b. _____

19. Elephantiasis is:

a. A disease caused by close association with elephants.
b. An enlargement and thickening of tissues as a complication of African trypanosomiasis.
c. A gross condition caused by the transmission of filarial worms by the tsetse fly
d. A late manifestation of filariasis.

20. African sleeping sickness is a central nervous system disease caused by a:

a. Virus, transmitted by a mosquito
b. Protozoan, transmitted by a tick
c. Protozoan, transmitted by the tsetse fly
d. Virus, transmitted by the tsetse fl.

21. Fleas are responsible for which of the following diseases in man?

a. Typhoid fever
b. Typhus (epidemic)
c. Typhus (endemic)
d. Rocky Mountain spotted fever
e. Phlebotomus fever
f. Plague

22. What role do rodents play in the spread of flea-borne disease?

a. Host for the flea vector
b. Vehicle of transmission
c. Reservoir for the causative agent

23. a. Plague is usually transmitted to humans by _____.

b. Primary pneumonic plague is generally caused by _____.

c. The typical case of primary pneumonic plague clinically resembles _____ _____.

24. List two main reservoirs for Lyme disease.

a. _____

b. _____

25. Scabies, like typhus, is a disease that accompanies wars. Why is this?

26. Trombicula mites are important to mankind only during the _____ stage.

27. The three environmental requirements for Lyme disease to appear in an area are:

a. _____

b. _____

c. _____

28. List two reasons why relaxing a tick with flame or heat in order to remove the tick from its host is a poor idea.

a. _____

b. _____

29. Under which of the following conditions are lice infestations common?

a. In temperature climates, where clothing is heavy and worn in several layers
b. In a climate where it is hot and people perspire profusely
c. In rural areas, where people pick up the infestation from trees and other vegetation

30. Ticks are responsible for transmitting which of the following diseases?

a. Scrub typhus
b. Rocky Mountain spotted fever
c. Russian spring-summer encephalitis
d. Epidemic typhus

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 5

1. The local population has had an opportunity to develop a degree of immunity to the disease. The American soldier, on the other hand, has not. (para 5-1d)

2. Active/biological (para 5-5b)

3. Passive/mechanical (para 5-5a)

4. Mosquitoes (para 5-7)

5. d (para 5-9a)

6. d (para 5-11b)

7. a (para 5-11a)

8. No. Flea collars coming in contact with human skin may cause severe chemical burns and absorption of toxic levels of insecticide through the skin. (para 5-13d, CAUTION)

9. a. A high percentage of casualties in a short time
   b. Result in military personnel being away from the duty station because of the long recovery period characteristic of the disease. (para 5-22c)

10. a. TRUE
    b. TRUE
    c. FALSE. (para 5-21b, 21c, 21d)

11. b, c, d (paras 5-21, 5-22, 5-23)

12. Larval control measures are not immediately effective against adult mosquitoes. Adult mosquitoes may live up to six weeks after the larviciding. (para 5-19)

13. Acute inflammatory diseases of comparatively short duration that involve the central nervous system. (para 5-23a)

14. b (para 5-24)

15. Shigellosis (para 5-28b(2))

16. 15 (para 5-28a)

17. An infected phlebotomine fly (para 5-30a)

18. a. Humans
    b. The sandfly (para 5-30a(1))

19. d (para 5-25)

20. c (para 5-32)

21. c, f (paras 5-35a, 5-36)

22. a, c (paras 5-33a, 5-34a)

23. a. The bite of a rat flea
    b. Inhaling plague organisms
    c. Lumbar pneumonia (para 5-35a(1), 5-35c, 5-35c(1))

24. a. Wild rodents
    b. Wild ungulates (especially deer) (para 5-37a(3))

25. In wars, keeping clean is difficult. (para 5-47)

26. Larval (para 5-45a)

27. a. Presence of small rodents
    b. Presence of ungulates (hoofed mammals)
    c. Ixodes ticks (para 5-37b)

28. a. May burn the host
    b. Could cause the tick to regurgitate rickettsiae into the host. (para 5-40a(2), CAUTION)

29. a (para 5-48)

30. b (para 5-38a)

End of Lesson 5

LESSON ASSIGNMENT

LESSON 6 Pest Management in a Field Environment

LESSON ASSIGNMENT Paragraphs 6-1 through 6-29

LESSON OBJECTIVES After completing this lesson, you should be able to:

6-1 Identify the subjects taught in the field sanitation course.

6-2 Define the mission of these Preventive Medicine teams in a theater of operations:

- The Sani team
- The Ento team

6-3 Identify the tasks in pest control operations to be performed by the following:

- Individuals
- Field sanitation team
- Preventive Medicine detachment

6-4 Identify the way biological agent pesticides and insect growth regulator pesticides reduce the arthropod population.

6-5 Identify the hazards of the following:

- Organic phosphorous compounds
- Carbamates
- Rodenticides
- Fumigants

6-6 Identify the first aid measures and antidotes for pesticide poisoning.

6-7 Identify the acute and chronic toxic effects of pesticides to the environment.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 6

PEST MANAGEMENT IN A FIELD ENVIRONMENT

Section I. RESPONSIBILITIES

6-1. COMMANDER

The commander is responsible for determining and putting into effect the necessary measures for the control of arthropod-borne diseases and the vectors that spread them.

- To assist him in this determination and implementation, the commander has qualified Corps of Engineers and Army Medical Department personnel.

- These individuals are qualified by training and experience in pest control operations.

6-2. CORPS OF ENGINEERS

The Corps of Engineers is responsible for insect and rodent control operations:

- At posts, camps, and stations within the United States.

- In oversea areas under static non-combat conditions when engineer services are established.

6-3. ARMY MEDICAL DEPARTMENT (AMEDD)

a. **Basic Responsibility.** The Army Medical Department is charged with responsibility for:

- Investigating and identifying the factors that affect the health of military personnel.

- Recommending and supervising measures for the control and prevention of disease in:

  -- Military personnel.
  -- Civilian personnel under military jurisdiction.
  -- Inhabitants of occupied territory.

b. **Combat Zone/Communications Zone.** In a combat zone or communications zone before the assignment of repair and utilities responsibilities to the Corps of Engineers, the Army Medical Department conducts all required control

operations, which are beyond the capabilities of field sanitation teams. It has the responsibility for:

- Conducting surveys to determine the requirements and the efficiency of control operations performed by others.

- Assisting commanders and supply personnel in establishing requirements and control levels for effective insecticides and dispersal equipment.

c. **AMEDD Advice to Commanders.** In advising commanders, the following principal factors should be considered:

- The military mission, estimated duration, and seasons.

- The arthropods present and the nature of the area during the mission.

- Control measures affected by:

  -- Local civilian health agencies.

  -- Nature and degree of military-civilian cooperation feasible.

  -- Necessity for placing populated areas off limits to military personnel.

- State of training of troops.

- Prevalence of mosquito-borne or arthropod-borne diseases.

Section II. ORGANIZATION FOR ARTHROPOD-BORNE DISEASE CONTROL

6-4. FIELD SANITATION TEAMS

The commanding officer of each company, battery, or similar unit is required by regulation (AR 40-5) to appoint a field sanitation team consisting of at least two men, one of whom must be a noncommissioned officer. Units having organic medical personnel should utilize company aid men as members of the field sanitation team. The members of the team must have a minimum of 6 months of remaining duty with the unit on the date of appointment.

a. **Field Sanitation Course.** The field sanitation team receives a 16-hour course of instruction in:

- The importance of basic sanitation in reducing the incidence of arthropod- and rodent-borne disease.

- Individual protective measures, to include the use of insect repellents, uniform impregnants, and protective clothing.

- The use and repair of insect screening and bed nets.

- The use of residual and space insecticide sprays for the control of flies and related pests.

- Rodent control measures.

- Food service sanitation.

- Unit waste disposal.

- Individual water purification procedures.

- Personal hygiene.

b. **Field Sanitation Team** - **Training Role.** Where repair and utilities responsibilities have been assigned to the Corps of Engineers, the field sanitation team is normally in a training role.

- The team, however, should conduct control operations within the unit area to the extent necessary to assure familiarity with measures outlined in paragraph 6-9a.

- The team should also conduct such operations within the unit area as are necessary for the protection of unit personnel when the unit is on field maneuvers or other training missions.

c. **Field Sanitation Team** - **Role in a Combat Zone or Communications Zone.** In a combat zone or communications zone prior to the assignment of repair and utilities responsibilities to the Corps of Engineers, the field sanitation team should carry out all control operations within the unit area which are necessary for the protection of unit personnel.

6-5. TOE PREVENTIVE MEDICINE PERSONNEL

A preventive medicine officer (MOS 60C) and both noncommissioned officers and specialists in MOS 91S (preventive medicine specialist) are included in the tables of organization of the headquarters company of the division medical battalion and the medical company organic to the separate brigade and armored cavalry regiment.

- These personnel:

  -- Assist in the training of unit field sanitation teams.

-- Make recommendations on the use of pesticides and pest control equipment within the division, separate brigade, or armored cavalry division.

- Units, which are not organic to one of these organizations, obtain similar support from the preventive medicine teams.

6-6. PREVENTIVE MEDICINE TEAMS

There are two types of preventive medicine teams available in a theater of operations. These are the Preventive Medicine Detachment (Sani) and the Preventive Medicine Detachment (Ento). Both units have 11 assigned personnel consisting of 2 officers and 9 enlisted soldiers.

a. **Preventive Medicine Detachment (Sani).** The Sani team is commanded by an Environmental Science officer with a Medical Entomologist as the executive officer. The enlisted soldiers are MOS 91S, Preventive Medicine Specialists. This team has the mission to investigate, identify, evaluate, and recommend action to improve sanitation of:

- Food service facilities.
- Troop housing.
- Water supplies.
- Waste disposal.
- Industrial hygiene.
- Other environmental problems.

The team has limited pesticides and dispersal equipment.

THE SANI TEAM

- Commander: Environmental Science Officer
- XO: Medical Entomologist
- Enlisted Personnel: 91S, Preventive Medicine Specialists

b. **Preventive Medicine Detachment (Ento).** The Ento team is commanded by a Medical Entomologist with an environmental science officer as the executive officer. The enlisted soldiers include a MOS 63B, Small Engine Mechanic, as well as Preventive Medicine Specialists. The Ento team has the same environmental capability as the Sani team, but its primary mission is to control arthropod vectors and rodent reservoirs of diseases that threaten deployed U.S. military forces.

THE ENTO TEAM

- Commander: Medical Entomologist
- XO: Environmental Science Officer
- Enlisted Personnel:
  -- 91S, Preventive Medicine Specialists
  plus
  -- 63B, Small Engine Mechanic

Section III. PEST CONTROL OPERATIONS

6-7. PEST CONTROL TASKS

To effectively control arthropod-borne diseases, pest control tasks must be distributed among the various organizational elements according to their capabilities.

6-8. INDIVIDUALS

Individuals have the task of implementing all possible personal protective measures.

6-9. FIELD SANITATION TEAM

a. **Tasks.** The Unit Field Sanitation Team conducts insect and rodent control measures within the unit area. This is commonly referred to as unit-level preventive medicine. Team members may perform the various tasks themselves, or they may supervise other members of the unit in the performance of the tasks. These tasks may include any of the following:

- The elimination of mosquito breeding sites such as ground pools and tire depression; "policing" the area for artificial breeding sites, such as tin cans and other containers; and treating fire barrels with oil or larvicides.

- Supervising the placement and maintenance of rodent bait stations and the application of insecticide dust for the control of rodent ectoparasites.

- Ensuring the proper disposal of liquid and solid wastes.

- Maintaining, when in malarious areas, a roster of personnel for the malaria chemoprophylaxis program.

- Conducting periodic food service sanitation inspections.

- Other tasks within the capabilities of the team and as directed by the unit commander.

INDIVIDUAL PROTECTION	UNIT PROTECTION	AREA PROTECTION
(Individual soldier)	(Field sanitation teams)	(Preventive medicine)
Materiel	***Materiel***	***Materiel***
Repellents. -- DEET. -- Permethrin.	2-gallon sprayer.	Aerial spraying equipment. Power sprayers. ULV machines.
Bed nets. Head nets.		
Protective clothing.	"New material"	
Aerosol bombs. Insect powder.	Space spray.	Rotary dusters. All insecticides. All rodenticides.
Malaria suppressives.	Fly swatters.	All material issued for individual and unit protection.

Table 6-1. Arthropod control capabilities.

b. **Equipment.** The field sanitation team has a limited amount of equipment and materials with which to accomplish its Pest management mission. An item of particular importance is the 2-gallon sprayer. The sprayer is used for spraying:

- Residual insecticides around buildings.
- Latrine.
- Garbage pits.
- Depressions in which water may collect.
- Other insect breeding areas.

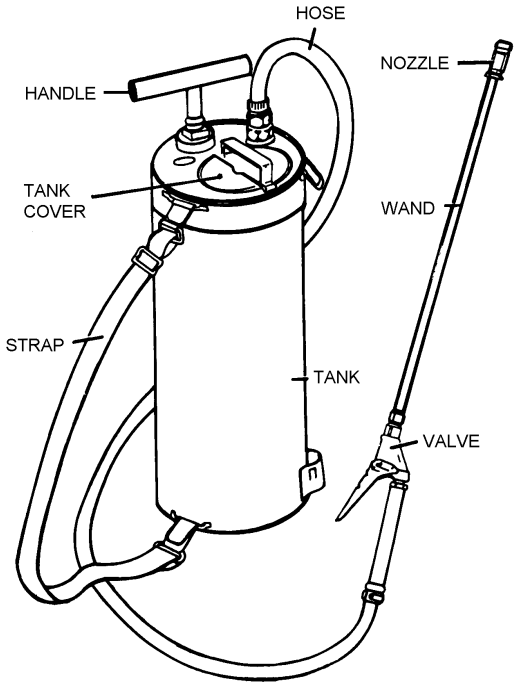


Figure 6-1. Compressed air sprayer (2-gallon).

6-10. PREVENTIVE MEDICINE DETACHMENTS

a. Tasks. When the magnitude of a pest control task exceeds the capability of the field sanitation team, the PM Detachment (Ento) may be called upon for assistance. An example of such a task would be the spraying of a large area, such as a series of rice paddies, a jungle, or a marsh adjacent to or within an area of operations.

Figure 6-2. Spraying a large area.

b. **Equipment.** The Ento team has a variety of equipment that gives it much greater capability than that of the Unit Field Sanitation Team.

- The manually operated rotary duster is particularly well adapted to the task of applying mosquito larvicides to rice paddies and other areas, which preclude the use of wheeled vehicles.

- The gasoline engine cowered backpack sprayer duster further enhances this capability.

- The Ento team has skid mounted Ultra Low Volume (ULV) sprayers to disperse insecticide for adult mosquitoes, as well as other power sprayers.

- The Ento team also has the aerial Pesticide Dispersal Unit (PDU).

  -- The PDU is a sling loaded on rotary wing aircraft.

  -- The aircraft must be provided by the requesting unit.

  -- The PDU can be configured to apply both liquid and granular pesticide formulations to areas up to 1500 acres, or smaller areas that are inaccessible to wheeled vehicles.

  -- If areas exceed 1500 acres require spraying, the requesting unit should submit a request for Air Force support.

  -- Submit the request through normal air request channels.

  -- The Air Force has fixed winged aircraft equipped for aerial spray missions over very large areas.

Section IV. PESTICIDES AND THE ENVIRONMENT

6-11. GENERAL

a. **Definition of Pesticide.** A pesticide is a material, usually a chemical, used to destroy unwanted plant or animal life. The term pesticide is, therefore, a broad term embracing several categories: insecticides, rodenticides, fungicides, herbicides, etc. This section concerns primarily the insecticides.

b. **Chemicals/Formulations.** Many types of chemicals and formulations are used in pest control operations. The insecticides, rodenticides, and other supplies standardized for military issue have been carefully selected to provide a minimum number of items with maximum military application and safety. With few exceptions,

these items, used as recommended, will provide satisfactory control of pests of military importance.

- The Defense Logistics Agency (DLA) maintains a list of standard pesticides with national stock numbers.

- This list changes frequently due to pesticide label cancellations, as well as the development of new pesticides.

NOTE: When a special problem is encountered which cannot be solved by the use of these items, qualified engineer or medical personnel may request the purchase of nonstandard items through appropriate channels**.**

6-12. CONCERN FOR THE ENVIRONMENT

For many years, insecticides were used more or less indiscriminately, with little thought to their impact on the environment. In recent years, however, an awakening of the public interest by environmentalist groups and government agencies has resulted in strict controls on the use of certain pesticides. In the following discussion of insecticides, emphasis will be given to those classes of chemicals known to have an adverse effect on the environment.

Section V. INSECTICIDES

6-13. DEFINITION OF INSECTICIDE

An insecticide is a material, usually a chemical, used to destroy unwanted insects. Insecticides may be classified several ways, but the most convenient method of classification is according to chemical properties.

6-14. INORGANIC INSECTICIDES

The inorganic insecticides are primarily compounds of heavy metals and arsenicals, such as Paris green (copper acetoarsenite), lead arsenate, and sodium arsenite. Although they still find uses in agriculture, these chemicals are not in the military inventory. Aluminum phosphide is the only inorganic insecticide on the stock list.

6-15. NATURAL ORGANIC INSECTICIDES

The natural organic insecticides are those that are derived from plants or other products occurring in nature.

a. **Kerosene and Diesel Oil.** Kerosene and diesel oil, both available from military stocks, can be used as mosquito larvicides. They are also used as carriers for some of the more toxic insecticides, which must be diluted for use.

b. **Pyrethrum.** One of the most effective and widely used natural organic insecticides is pyrethrum, which is derived from one variety of chrysanthemum flower.

- Pyrethrum is a powerful contact insecticide causing a rapid paralysis or "knockdown" of the treated insect.

- It is effective as a direct contact or space spray against adult flies, mosquitoes, and other flying insects.

- It lacks persistence and has virtually no residual action.

- Many insects, especially cockroaches, recover after an initial contact.

- Pyrethrum is one of the least toxic of all insecticides to mammals, and its use poses no environmental hazard.

c. **Synthetic "Pyrethroids."** Because of the high cost of pyrethrum, several synthetic "pyrethroids" have been developed which mimic the activity of pyrethrum and are now being substituted for pyrethrum in the standard pressurized aerosol can.

6-16. SYNTHETIC ORGANIC INSECTICIDES

The synthetic, or man-made, insecticides first came into use with the synthesis of DDT in 1939. During and following World War II, their use and development mushroomed. There are currently three categories of synthetic organic insecticides in the Army inventory: chlorinated hydrocarbons, organic phosphates, and carbamates.

a. **Chlorinated Hydrocarbons.** These chemicals are characterized by their prolonged residual effect. Some have shown effective persistence for over 10 years in tests where massive soil treatment was used, as in termite control. Because of this persistence, the registrations for several of the chlorinated hydrocarbons have been suspended or cancelled (DDT for example).

NOTE: There are currently no chlorinated hydrocarbons on the Army stock list.

b. **Organic Phosphates.** The organic phosphates are characterized by faster action and more rapid decomposition than the chlorinated hydrocarbons. For this reason, they are not considered as detrimental to the environment as are the chlorinated hydrocarbons. To human applicators, however, they may pose greater health and safety hazards than the chlorinated hydrocarbons.

--CAUTION--

Exercise great caution when using this group of insecticides.

Organic phosphates on the Army stock list include Malathion®, diazinon, and dursban.

c. **Carbamates (Organic Sulfur Compounds).** The carbamates are relatively new insecticides.

- They generally have a lower toxicity to mammals than many of the organic phosphates.

- But they have a longer residual effect (which is still considerably shorter than that of the hydrocarbons).

- Carbamates currently stocked by the Army are:

  -- Carbaryl (Sevin®).
  -- Propoxur (Baygon®).
  -- Bendiocarb (Ficam®).

6-17. BIOLOGICAL AGENTS

Because of concerns for human health and environmental safety, there has been great interest in developing safer pesticides. A result of this is the use of natural pathogens and predators of disease vectors and arthropod pests. Viruses, bacteria, and fungi have all been successfully used to reduce arthropod populations.

a. The bacteria *Bacillus thuringiensus* var. *israelensis* (bti) is the most widely used of these agents for mosquito control.

b. The most widely used predator of mosquito disease vectors is the mosquito fish, *Gambusia* species.

c. The predaceous mosquitoes in the Genus *Toxorhynchites* have also been used to reduce mosquito vectors populations.

6-18. INSECT GROWTH REGULATORS (IGR)

The search for safer pesticides has also resulted in the use of synthetic hormones to control insects. Methoprene is a synthetic growth regulator that has been extensively used to control mosquitoes and other insect pests.

a. When immature insects are physiologically ready, they produce a hormone that causes them to molt to the next stage of development.

b. If immature insects are exposed to synthesized hormones before they are physiologically ready, they either do not molt or are sterile when they develop into adults.

Section VI. RODENTICIDES

6-19. GENERAL

The rodenticides selected for the military supply system provide adequate rodent control under a wide range of conditions. These compounds are used mostly as poisons in food baits or in water solutions. Since the success of any poisoning program depends upon the rodent accepting the bait, care should be given to its selection. Acceptable bait material will vary depending upon the preferences of the species or population of rodents being controlled. Test foods may be selected from each of the following types:

a. **Cereals**. (Foods such as, cornmeal, bread, oatmeal, whole grains, poultry mash.)

b. **Proteins and Fats**. (Foods such as, meats, fish, cooking grease, peanut butter.)

c. **Fruits and Vegetables (melons, sweet potatoes, coconuts, bananas).** Raw products native to the control area may be more acceptable to the rodents than unfamiliar foods.. Generally, rodents avoid acid fruits and vegetables such as citrus and tomatoes. Moldy and rotten food is also avoided.

6-20. ANTICOAGULANTS AND BAITS

a. **Anticoagulants in Rodenticides.** These rodenticides contain chemicals that cause internal bleeding by reducing the clotting ability of the blood. Since anticoagulants affect all warm-blooded animals by preventing the clotting of blood, precautions should be taken to prevent humans, domestic animals, and pets from eating baits containing anticoagulants.

b. **Effects of Anticoagulant Pesticides.** Pesticides containing anticoagulants are stable, and are odorless and tasteless to rodents in the concentrations used. A single feeding on bait containing an anticoagulant at the recommended concentration is not sufficient to cause death. Food baits or water solutions must be consumed over a period of several days. Bait should be placed in a bait station or in a place that offers the rodent a protected feeding place and protects the bait from domestic animals and the weather.

c. **Life of Bait.** Spoiling of bait material will depend on the type of food used and on climate conditions. Dry cereal baits remain in good condition much longer than

meat or vegetables baits and are, therefore, the foods of choice for use with anticoagulants. Baits should be replenished before they are completely eaten to prevent the rodents from abandoning the feeding stations.

d**. Formulations.** Anticoagulant rodenticides are provided in two formulations:

- A prepared material, ready for use.
- Concentrate for use in the preparation of food baits or water solutions.

e. **The Active Ingredient.** The active ingredient may be one of the following chemicals:

- Diphacinone.
- Fumarin.
- Warfarin.
- Pivai.
- PMP.

6-21. IDENTIFICATION

Rodenticide bait, anticoagulant, is ready-to-use bait. It contains an anticoagulant chemical, roiled oats, sugar, and mineral oil to increase its acceptability. A red dye has been added to distinguish it from human food. The item is used directly from its container without further mixing.

6-22. PREPARATION/USE

Rodenticide, anticoagulant, universal concentrate is a concentrate that can be mixed with food bait or with water.

a.. It consists of a water-soluble anticoagulant chemical, sugar to make water solutions more palatable, sodium benzoate as a preservative, and a complexing agent to hold the anticoagulant in solution.

b. Glass, plastic, or paper water-holding containers may be used for dispensing. Poisoned water is especially effective where water is scarce.

c. The use of poisoned water and poisoned baits simultaneously will increase the effectiveness of the control program.

Section VII. FUMIGANTS

6-23. GENERAL

Fumigants are considered separately from other pesticides because of their particular characteristics. Fumigants are extremely toxic and enter the body through the respiratory system.

a. **Use.** They are used primarily as a fast, direct, and effective means of eliminating all stages of living insects in stored products, buildings, ships, and similar situations where only a gas will penetrate to the hiding places of the insects.

b. **Effectiveness.** Because of the highly toxic nature of fumigants, they are also effective against rodents, which may be present at the time the fumigant is applied. The fumigants have only immediate effects. When the gases are allowed to escape following a fumigation operation, they break down rapidly and pose no threat to the environment.

NOTE: Because of their gaseous nature, however, some fumigants may have the added hazard of fire.

c. **Application.** Fumigants may be applied only by trained personnel who have passed a technical competency test designed to show a satisfactory knowledge of the properties of fumigants and methods for their safe application.

6-24. FUMIGANTS USED BY THE ARMY

Aluminum phosphide, upon exposure to atmospheric moisture, releases a gas known as hydrogen phosphide, PH_3 or phosphine.

a. **Characteristics.** The gas has an odor like garlic, and can penetrate even closely packed commodities.

b. **Use.** Fumigants are used for:

- Fumigation of stored products (such as flour, noodles, rice, dog food, and so forth) indoors or outdoors, but only under polyethylene tarpaulins, which must be sealed to the floor or ground.

- Cannot be used with cloth or canvas tarpaulins.

- Effective for the treatment of stored products in sealed boxcars or hopper cars, whether static or rolling.

NOTE: Hydrogen phosphide gas can explode if under vacuum, and must be used only under atmospheric conditions.

c. **Action.** Aluminum phosphide leaves treated material and the fumigated stack within *1* hour with normal ventilation procedures. Under specific atmospheric conditions involving moisture condensation on the item being fumigated, phosphine will corrode copper or products containing copper. For this reason, such items must not be placed in an area where condensation may occur or covered in a manner that may induce condensation.

d. **EPA Label Instructions.** In accordance with EPA label instructions, aluminum phosphide must not be used in such a manner as to allow the pellets, tablets, or unreacted residues (ash) to encounter any processed food. With this exception, PH_3 will not combine in any form to produce a food residue.

e. **Phosphine. Phosphine is** highly toxic to all forms of human, insect, and other animal life. For this reason, application must be closely supervised by the engineer or medical entomologist. Personnel engaged in the application of this fumigant must be certified and specially trained, and must have proper respiratory protective devices on hand during the fumigation procedure.

Section VIII. PESTICIDE SAFETY

6-25. GENERAL

Guidance and training of nest control operators in the application of toxic chemicals are major responsibilities of the military entomologist. Commanding officers depend upon him for technical advice on the safe and efficient use of these valuable control materials.

a. **Responsibilities of Military Entomologist Compared to Responsibilities of a Physician.** The development in recent years of a great many different pesticides with varying degrees of toxicity and hazard has made this responsibility comparable in many respects to that of the physician for prescription of drugs. Recommendations must include the:

- Most suitable method of application.
- Dosage.
- Precautions.
- Limitations.
- Chemical of choice for each program.

b. **Implications of Safe Application of Pesticides.** The safe application of pesticides implies that there will be minimum hazard to desirable species and adequate

protection of human food and water as well as of the operators and other exposed personnel.

6-26. TOXICITY

a. **Organic Phosphorous Compounds.** This group of pesticides has a wide range of mammalian toxicity, from a very low order, as in malathion, to a moderate order, as in diazinon. This group of chemicals inhibits cholinesterase, an enzyme essential to the proper functioning of the body.

(1) Signs/symptoms. Mammalian poisoning from organic phosphorous pesticides involves the central nervous system. Symptoms of poisoning may include:

- Pinpoint eye pupils.
- Gastrointestinal discomfort.
- Salivation.
- Profuse sweating.
- Difficulty in breathing.

As with poisoning due to chlorinated hydrocarbons, the immediate cause of death is usually respiratory failure.

(2) Hazard/protection. Because this group of pesticides is used more frequently than chlorinated hydrocarbons, a greater danger to the applicator is posed. Maximum use of protective measures must be employed.

b. **Carbamates.** This group of compounds also inhibits cholinesterase and exhibits a wide range of toxicity and hazard. The safety requirements for the applicator are identical with those for the organic phosphates.

c. **Rodenticides.** The materials in this group are inorganic and organic chemicals but the uses and modes of action are sufficient to justify consideration of rodenticides as a separate group.

- The organic chemical group has been the cause of most human poisoning associated with rodenticides.

- The anticoagulants, on the other hand are widely used in rodent control programs today with a high degree of safety. One of the early members of this group is known as “Warfarin,” which is being supplemented in the military supply system by other anticoagulants in water-soluble formulations.

- In addition to causing capillary damage, these chemicals interfere with the formation of prothrombin, resulting in extensive internal hemorrhages.

- These chemicals have the advantage of low acute toxicity; consequently, in the concentrations recommended, repeated ingestion over a period of several days is required to produce lethal poisoning in mammals, including man.

- Accidental or deliberate ingestion of these anticoagulants particularly of the concentrates, may lead to death.

- Depending on systemic levels reached, repeated prolonged exposure may result in disease conditions ranging from prolonged bleeding from minor cuts to serious hemorrhagic phenomena.

d. **Fumigants.** The Army uses fumigants for specialized problems with insect control, particularly control of pests in stored commodities such as food and clothing.

- Hydrogen phosphide gas, from aluminum phosphide, is extremely toxic to humans in concentrations sufficient for insect control. The garlic odor is not a dependable indicator of the presence of the gas. Appropriate gas monitoring devices and special gas masks must be available and with the applicator at the fumigation site.

- The medical authority and provost marshal should be informed of all fumigations before they are initiated.

- Symptoms of poisoning are:

  -- Tightness of chest.
  -- Dry cough.
  -- Vomiting.
  -- Diarrhea.

Early symptoms are obvious and readily reversible.

6-27. FIRST AID

a. **The First Consideration.** The first consideration when an accident occurs, such as gross contamination of the body with concentrates or the inhalation of poisonous gases, is the removal of the victim from the toxic atmosphere or from other types of continued exposure.

b. **The Second Consideration.** The second consideration is artificial respiration, if the victim is unconscious and not breathing. Medical aid must then be obtained.

c. **Simultaneous Measures.** Simultaneous measures while awaiting medical aid or en route to it would include:

- Removal of contaminated clothing.

- Dousing with water or washing contaminated skin areas.

- Artificial respiration, mouth-to-mouth if victim is unconscious.

d. **General Measures.** A person with knowledge of the incident should accompany the victim to the medical facility to inform qualified medical personnel about the:

- Nature of the accident.

- The material being use.

- The first aid given.

- The victim's course following exposure up to the time of his arrival at the medical facility.

The poison container or a label from it should be delivered with the patient to the medical facility.

6-28. ANTIDOTES

a. **Notification.** The responsible supervisor at each military installation where pesticides are used must ensure that the nearest medical facility is informed of the chemicals being used, so that antidotes can be made available and medical officers will be aware of toxic symptoms. Information regarding appropriate treatment may be obtained from the nearest poison control center.

b. **Reducing the Exposure.** No matter what the nature of the poison, it is important to reduce the exposure.

- Anyone who has collapsed in an atmosphere of toxic gas should be removed to fresh air at the earliest possible moment by soldiers with adequate protection.

- In the case of other exposures, decontamination should be carried out as soon as the condition of the patient permits.

- If poison has been taken internally, a saline laxative may be used to speed evacuation of the gut; oil laxatives should be avoided where it is possible that an organic solvent or a chlorinated hydrocarbon insecticide is involved.

- If the skin has been contaminated, it should be washed thoroughly with soap and water.

- If the eyes have been splashed, the face should be washed and the eyes irrigated with water.

6-29. ENVIRONMENTAL CONTAMINATION

a. **Acute Toxic Effects of Pesticides.** The preceding discussion emphasized the acute toxic effect of pesticides. These effects can largely be prevented through the careful storage and handling of pesticide in accordance with guidance contained on the label and in the appropriate Department of Defense technical publications.

b. **Chronic Effects of Pesticides.**
Of more concern in recent years, however, are the chronic effects of pesticides resulting from low-level exposures over long periods of time.

- These low-level exposures come, to a great extent, from the pesticide residues in the environment. The chlorinated hydrocarbons, notably DDT, have come under particular criticism because of their persistence and the ability of animals to store their residues in body fat.

- This phenomenon leads to a condition referred to by environmentalists as biomagnification.

-- Biomagnification is the successive buildup of pesticide residues in each link of the food chain as predatory forms of life accumulate in their bodies the residues present in the bodies of their prey.

-- For example, in a study of aquatic life in Lake Michigan, it was found that in water having a DDT content of .014 ppm, plankton living in that water had a content of .4 ppm DDT.

-- The residue found in fish from the same water was 6 ppm, while the concentration in gulls feeding on those fish was 100 ppm.

-- The same process takes place among land animals, but it is not so pronounced as with water life. The environmental contamination, which causes this situation, occurs via three routes of contamination: air, water, and soil

c. **Air Route.** Much of the pesticide contamination occurs through the air route by aerial application of liquids or dusts, or by spraying with ground equipment during unfavorable ground conditions. The following factors are important in aerial dispersal of pesticides and also, to a lesser degree, in spraying with ground equipment:

(1) Temperature. Spraying operations should be conducted when the difference between the surface air and the air at higher altitudes is minimal, and when a normal, or lapse condition exists.

- A lapse condition is one in which the air at ground level is warmer than the higher-level air.

- When the air at higher altitudes is warmer than at the surface, this is known as a temperature inversion. When a temperature inversion exists, there is lateral as well as vertical air movement, causing particles to drift far from the target area.

(2) Wind. Wind speeds greater than 8 miles per hour are generally considered unfavorable for pesticide spraying.

(3) Dust. Dusty conditions are unfavorable for pesticide spraying because of the tendency of the chemicals to adhere to the dust particles and be carried long distances.

(4) Droplet size. Smaller droplets, being lighter, will carry farther with the wind than will larger, heavier droplets. This factor is largely a matter of equipment design.

(5) Formulation. The type of formulation being used is also a factor in pollution by the air route, since dusts are lighter and will carry farther than liquids.

d. **Water Route.** The water route is probably the most important means of pesticide pollution, since virtually everything, which reaches the ground, is subject to runoff with rainfall.

- Neither vertical movement into ground water sources (wells and springs) nor washing of pesticide particles in the atmosphere by raindrops is an important consideration in this respect.

- The vast majority of water pollution occurs by direct application of pesticides to the water by aerial spraying or through surface runoff.

- This source of pollution cannot be eliminated, but it may be minimized by applying pesticides only when necessary and then only in recommended strengths and dosage rates.

e. **Soil Route.** The soil provides an important source of pesticide contamination.

- During dry weather, dusty soil that has been subjected to pesticide treatment is easily picked up by gusts of wind and transported to other areas.

- In addition, the soil affords a medium in which pesticides may persist for some time.

-- In this respect, the persistence of a chemical may be enhanced by the composition of the soil.

-- For example, parathion, a relatively non-persistent chemical, has remained lethal for one month in clay soil with a high organic content.

Continue with Exercises

EXERCISES, LESSON 6

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. List two basic responsibilities of the Army Medical Department.

   a. _____

   _____

   _____

   b. _____

   _____

   _____

2. List four principal factors AMEDD should keep in mind when advising commanders about arthropod-borne diseases.

   a. _____

   b. _____

   c. _____

   d. _____

3. List five subjects taught in the field sanitation course.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

4. a. The mission of the Sani preventive medicine team is to _____ _____.

   b. The mission of the Ento preventive medicine team is to _____ _____.

5. Tasks of the unit-level field sanitation team include:

   a. Maintaining, when in a malarial environment, a roster of personnel for the malaria _____ program.

   b. In regard to food service, conducting periodic _____.

6. If pest control requires spraying of an area greater than 1500 acres, the preventive medicine team should _____ _____.

7. a. A pesticide is a material used to _____ _____.

   b. An insecticide is a material used to _____ _____.

8. a. Pyrethrum, a natural organic pesticide derived from one variety of chrysanthemum flower, is effective as a direct contact or space spray against _____ and other flying insects.

   b. One insect that can recover after initial contact with the pesticide pyrethrum is the _____.

9. In the statements below, write in the name of the pesticide that is hazardous to a pesticide applicator.

   a. Pinpoint eye pupils, salivation, and difficulty in breathing are signs/symptoms of poisoning from _____ pesticide.

   b. If not applied with safety measures in mind, chemical _____ pesticides can cause extensive internal hemorrhaging in humans.

   c. Before using a fumigant pesticide to control pests in areas in which food or clothing are stored, the Army should inform the _____ _____ and the _____ _____.

10. List two reasons the nearest medical facility must be informed of the chemicals being used when a military installation is using pesticides.

   a. _____
   _____.

   b. _____
   _____.

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 6

1. a. Investigating and identifying the factors that affect the health of military personnel.
   b. Recommending and supervising measures for the control and prevention of disease in military personnel, civilian personnel under military jurisdiction, and inhabitants of an occupied country. (para 6-3a)

2. You are correct if you listed any four of the following:

   - The military mission, estimated duration, and seasons.
   - The arthropods present and the nature of the area during the mission.
   - Control measures effected by local civilian health agencies.
   - Nature and degree of military-civilian cooperation feasible.
   - Necessity for placing populated areas off limits to military personnel.
   - State of training of troops.
   - Prevalence of mosquito-borne or arthropod-borne diseases. (para 6-3c)

3. You are correct if you listed any five of the following:

   - Importance of basic sanitation in reducing the incidence of arthropod- and rodent-borne disease.
   - Individual protective measures, to include the use of insect repellents, uniform impregnants, and protective clothing.
   - The use and repair of insect screening and bed nets.
   - The use of residual and space insecticide sprays for the control of flies and related pests.
   - Rodent control measures.
   - Food service sanitation.
   - Unit waste disposal.
   - Individual water purification procedures.
   - Personal hygiene. (para 6-4a)

4. a. Investigate, identify, evaluate, and recommend action to improve sanitation of food service facilities, troop housing, water supplies, waste disposal, industrial hygiene, and other environmental problems
   b. Control arthropod vectors and rodent reservoirs of diseases that threaten deployed U.S. military forces. (para 6-6a and b)

5. a. Chemoprophylaxis
   b. Food service sanitation inspections (para 6-9a)

6. Request Air Force support through normal air request channels. (para 6-10)

7. a. Destroy unwanted plant or animal life. (para 6-11a)
   b. Destroy unwanted insects. (para 6-13)

8. a. Adult flies
      Mosquitoes
   b. Cockroach (para 6-15b)

9. a. An organic phosphorous compound (para 6-26a)
   b. Rodenticide (para 6-26c)
   c. Medical authority. Provost Marshall (para 6-26d)

10. a. Stock antidotes
    b. Medical officers be aware of toxic signs and symptoms. (para 6-28a)

End of Lesson 6

LESSON ASSIGNMENT

LESSON 7	Miscellaneous Diseases and Immunizations
LESSON ASSIGNMENT	Paragraphs 7-1 through 7-22
LESSON OBJECTIVES	After completing this lesson, you should be able to:

7-1 Identify epidemiological features of rabies, hepatitis, and other selected miscellaneous diseases.

7-2 Identify characteristic symptoms of rabies.

7-3 Select appropriate measures for the control of rabies and hepatitis.

7-4 Identify the major mechanisms of immunity.

7-5 Identify the routine and the special immunizations administered in the Army Immunization Program.

7-6 Identify the major provisions of the Army Immunization Program as it relates to the immunizing of military personnel and their dependents.

SUGGESTION After studying the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.

LESSON 7

MISCELLANEOUS DISEASES AND IMMUNIZATIONS

Section I. VIRAL HEPATITIS

7-1. INTRODUCTION

a. **Military Importance.** Hepatitis has always been a disease of concern to the military. The true impact of viral hepatitis was difficult to ascertain before the availability of serologic tests. The Army was responsible for one of the major studies which differentiated “short’ and “long” incubation hepatitis when, in World War II, a batch of yellow fever vaccine was contaminated with the virus. Fifty thousand cases of hepatitis resulted.

b. **In Military History**. A major problem with the hepatitis B virus was documented in the U.S. troop population in Korea through the 1960s. Attack rates in the range of 8 to 10 per thousand (among 50,000 troops) resulted in a policy of immune globulin use for all deployed soldiers. By 1970, rates were one-half to one-third of the earlier rates.

c. **Sanitation**. Sanitation has had the greatest effect in the incidence of hepatitis A and hepatitis E that are considerably less prevalent in the developed nations than in third world countries.

7-2. GENERAL CONCEPTS ABOUT HEPATITIS

a. **Identification.** Hepatitis is an inflammation of the liver. There is a broad spectrum of potential causes.

- Chemical causes (substances such as ethyl alcohol, mushroom toxins, carbon tetrachloride)

- Latrogenic causes (a variety of drugs such as acetaminophen, isoniazid)

- Infectious causes (a variety of agents such as malaria, herpes simplex, toxoplasmosis)

POTENTIAL CAUSES of HEPATITIS

- Chemical causes
- Latrogenic causes
- Infectious causes

b. **Hepatitis Viruses**. Currently, these are the recognized hepatitis viruses:

- Hepatitis A--HAV, picornavirus.
- Hepatitis B--HBV, DNA, hepadnavirus.
- Hepatitis C--HCV, RNA, flavivirus, probably more than one type
- Hepatitis D--HDV, Delta agent, RNA, incomplete viral particle that can replicate only in conjunction with Hepatitis B
- Hepatitis E--HEV, RNA, one virus, or one family

c. **Clinical Picture of Hepatitis**. The acute disease is similar in all types of viral hepatitis. The disease ranges from asymptomatic and inapparent illness to flu-like symptoms or malaise to fulminant and fatal disease. Severity generally increases with age.

(1) Major phases. Three major phases can be identified:

- Prodromal phase. The severity varies with the patient. Signs and symptoms include anorexia, nausea, vomiting, fatigue, malaise, headache, myalgias, arthralgias, pharyngitis, cough, low-grade fever, and so forth.

- Jaundice phase. The constitutional symptoms diminish. Jaundice appears. The urine is dark, and the stools are clay-colored. The liver is enlarged and tender.

- Recovery phase. Gradually, the signs and symptoms diminish. This phase can last anywhere from a couple of weeks to several months.

(2) Complications/treatment.

- Complications. Death is rare, but it can occur, as can some other rare complications. Chronic disease, carrier states, cirrhosis of the liver, and liver cancer are all potential possibilities with hepatitis B, C, and 0.

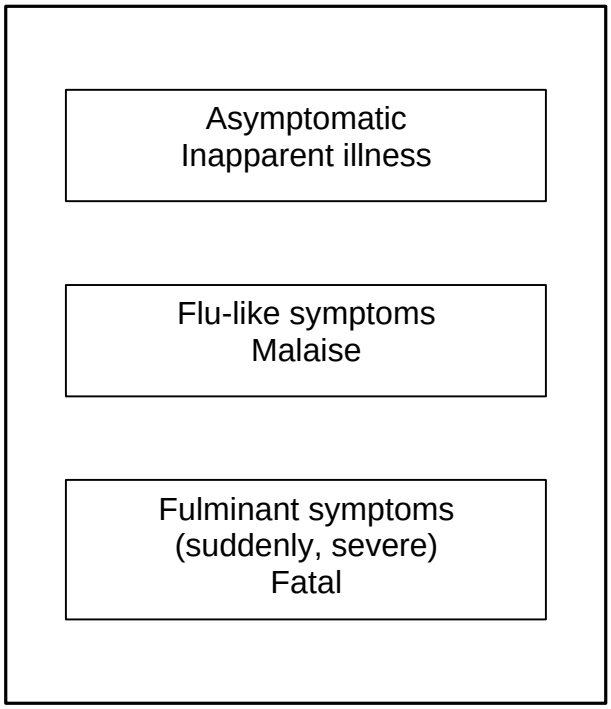


Figure 7-1. Range of hepatitis symptoms

- Treatment. Give supportive therapy. Before 1990, there was no effective treatment for acute or chronic hepatitis. Now there is treatment for both chronic hepatitis B and hepatitis C.

  -- Forty to fifty percent of HCV patients have an improved liver condition with treatment.

  -- For chronic HDV patients, forty percent improve with treatment.

Hepatitis Type	Identification	Occurrence	Reservoir	Transmission
A	♦ Varies in severity from mild to severely debilitating. ♦ Abrupt onset with fever, malaise, anorexia, nausea, abdominal discomfort--then jaundice.	♦ Worldwide.	♦ Man.	♦ Fecal-oral route from person to person.
B	♦ Gradual onset with anorexia, vague abdominal discomfort, nausea and vomiting, rash, often progressing to jaundice.	♦ Worldwide.	♦ Man.	♦ The virus has been found in all body secretions and excretions. Only blood, saliva, semen, and vaginal fluids have been seen to be infectious.
C	♦ Onset of anorexia, vague abdominal discomfort, nausea and vomiting, progressing to jaundice less frequently than hepatitis B.	♦ Worldwide. ♦ Common post-transfusion hepatitis in the U.S. More common when paid donors are used.	♦ Man.	♦ By injected contaminated blood and plasma derivatives
D	♦ Abrupt onset with signs and symptoms similar to those of hepatitis B. ♦ Self-limiting or may progress to chronic hepatitis.	♦ Worldwide.	♦ Man.	♦ Similar to hepatitis B, including exposure to blood and serous body fluids, contaminated needles, syringes and plasma derivatives, and sexual transmission.
E	♦ Similar to hepatitis A. ♦ No evidence of a chronic form.	♦ India, Burma, Nepal, Pakistan, the USSR, Algeria, Libya, Somalia, Mexico, and China.	♦ Man.	♦ Water which is contaminated. ♦ Probably person-to-person by the fecal-oral route.

Table 7-1. Types of hepatitis + pertinent information.

METHODS OF CONTROL		
Type of Hepatitis	Preventive Measures	Control of Patient, Contacts and Immediate Environment
A	• Educate about: good sanitation; personal hygiene; emphasize careful handwashing; emphasize sanitary disposal of feces. • Provide: proper water treatment; proper sewage disposal. • Heat oysters, clams, and other shellfish from contaminated areas to a temperature of 185-194°F for 4 minutes before eating. (Steam for 90 seconds.) • Passive immunization with immune globulin (IG) is highly effective in preventing or reducing disease. The protection, however, is short-lived and must be repeated every 6 months. • Vaccine is very effective. Two doses are given 2 to 4 weeks apart.	• Isolation for proven hepatitis A cases. • Sanitary disposal of feces, urine, and blood. • Immunize contacts. • If hepatitis A has occurred in a foodhandler, give IG to other foodhandlers in the establishment. IG is not usually offered to patrons. • If there is a case of hepatitis A in a daycare center, give IG to all classmates. • Specific treatment for patient: None.

Table 7-2. Hepatitis--methods of control. (continued)

B	◆ Educate. ◆ Avoid high risk behaviors. (There is a decrease in hepatitis B due to a change in risk behaviors -- not due to vaccine.) ◆ Recommend vaccine for the high-risk group: -- Users of drugs which are injected. -- The sexually active. -- Health care and public safety personnel. -- Household and sexual contacts of carriers. ◆ Enforce strict discipline in blood banks, testing all blood for hepatitis B. ◆ Sterilize all syringes, needles, and stylets. (Prefer using disposable equipment.)	◆ Isolation. ◆ Universal precautions, especially for blood and body fluids. ◆ Disinfect equipment contaminated with blood, saliva, or semen. ◆ Immunize contacts. ◆ Specific treatment: None.
C	◆ Same general measures as for hepatitis B. ◆ Universal precautions when handling body fluids. ◆ Screen donated blood.	◆ Same as for hepatitis B.
D	◆ Same as for hepatitis B. ◆ Prevention of hepatitis B infection prevents infection of hepatitis D. ◆ For hepatitis B carriers, avoid exposure to any potential source of hepatitis D.	◆ Same as for hepatitis B.
E	◆ Provide educational programs stressing sanitary disposal of feces and careful handwashing after defecation and before handling food. ◆ Basic measure to prevent fecal-oral transmission.	◆ Isolation and concurrent disinfection as for hepatitis A. ◆ Specific treatment: None.

Table 7-2. Hepatitis--methods of control. (concluded)

Section II. TETANUS

7-3. IDENTIFICATION

Tetanus is a disease caused by the toxin of an anaerobic bacillus, *Clostridium tetani,* and characterized by local to generalized painful muscular contractions, plus convulsions.

7-4. THE INFECTION

The bacillus produces a resistant spore, which may frequently be found in the feces of horses and less frequently in the feces of man and other domestic animals.

- The spores are found in soil throughout the world, and they produce infection by direct or indirect inoculation of a wound.

- The disease may follow any wound, burn, surgery, or trauma to an old wound containing dormant spores.

- In 10 to 20 percent of cases, there is no prior history of wounding or trauma.

7-5. SIGNS/SYMPTOMS

The toxin acts in the spinal cord. The incubation period is 4 days to 3 weeks. The earliest and most frequent sign is stiffness of the jaw, followed by spasm of the muscles of the neck and jaw (lockjaw). Severity varies with the length of the incubation period.

7-6. MORTALITY

Mortality is due to respiratory failure from spasm of the respiratory musculature. The mortality varies from 30 to 70 percent in the U.S.

7-7. TREATMENT

Treatment consists of adequate debridement of the wound, tetanus antitoxin in massive doses, penicillin, sedation, prevention of respiratory spasm, and respiratory support.

7-8. PREVENTIVE MEASURES

Preventive measures include adequate cleansing of wounds, immunization with tetanus toxoid or antitoxin, and surgical asepsis. Tetanus toxoid is very effective in the prevention of tetanus. Only four cases of tetanus occurred during World War II among wounded American soldiers who had been fully immunized and received an emergency booster at the time of injury.

Section III. ZOONOSES: RABIES

7-9. EPIDEMIOLOGY

Rabies is an acute viral infection of mammals--particularly the carnivores--characterized by severe irritation of the central nervous system, followed by paralysis and death.

a. **Importance to Humans**. It is not an important disease from the standpoint of morbidity, since few human cases occur. Psychologically, however, rabies is extremely important, in that it is, for all practical purposes, an invariably fatal disease once the symptoms have appeared. Only one case of a survivor has been documented in the U.S.

b. **Transmission.** The agent causing rabies is a virus present in the saliva of a rabid animal. The domestic dog is the most important reservoir in transmitting the disease to man; but many wild animals--especially foxes, wolves, skunks, raccoons, and bats -- also carry the disease and occasionally have been involved in human cases. The disease is usually transmitted from animal to animal or animal to man when infected saliva enters a break in the skin, usually by means of a bite. It is also possible for the disease to be transmitted by exposure of a fresh wound or skin abrasion to infected saliva. From the site of entry, the virus travels to the central nervous system and to the salivary glands.

7-10. CLINICAL FEATURES

a. **Incubation Period**. The incubation period for rabies is from 30 to 50 days in man and 3 to 8 weeks in animals, although it has been known to vary from 10 days to over a year.

- In cases where the patient has been bitten extensively or about the head, the incubation period is shorter.

b. **Infective Period**. The infective period, during which the virus is present in the saliva, is from 3 to 5 days before symptoms appear until death, in dogs and cats. In other animals, it may be much longer.

c. **Symptoms in Man**.

- The early symptoms of rabies in man are mental depression, restlessness, malaise, and fever.

- Restlessness increases to uncontrollable excitement, and spasms of the pharyngeal muscles cause extreme pain --particularly when trying to swallow or drink (hence the term hydrophobia, or fear of water).

- Death usually occurs within 3 to 5 days from exhaustion, general paralysis, or asphyxiation.

d. **Symptoms in Animals**. The symptoms of rabies in animals occur in three

- Prodromal stage. The prodromal stage lasts from 2 to 3 days and consists in dilated pupils and fever.

- Excitation stage. The second stage, which lasts from 3 to 7 days, is the excitation stage. This is the most dangerous stage, during which the disease may take two forms.

-- In the "furious" form the animal become vicious and agitated, biting obsessively at both animate and inanimate objects. Paralysis of the pharyngeal muscles causes excessive salivation, or frothing at the mouth.

-- In the "dumb" form, the animal is lethargic and has a dropped lower jaw. This form is particularly dangerous in the case of wild animals, who appear to be tame, whereas they are actually ill with rabies and may bite if approached.

- Paralytic stage. The third stage, which lasts 1 to 4 days, is the paralytic stage, characterized by paralysis of the neck and jaw, general paralysis, and death.

7-11. RABIES PREVENTION

a. **Prevention**. Since there is no known cure for rabies (the one documented survivor was saved by symptomatic treatment consisting of respiratory and cardiac support), prevention is paramount. Essential preventive measures include animal control and prophylaxis.

b. **Animal Control**. All dogs should be vaccinated for rabies, registered, and licensed, in congested areas, they should be kept on leashes unless confined to the owner's property. Dogs and cats that have been bitten by a rabid animal should be destroyed or detained for 6 months in a pound or kennel. Stray dogs should be collected and destroyed. Dogs known to have bitten persons should be detained alive for 10 days. If the dog was infective at the time of the bite, symptoms of rabies will appear within 10 days. If it is not possible to capture the animal alive, the head should be sent intact, packed in ice, to an appropriate laboratory for examination.

c. **Prophylaxis**.

(1) Immunization. Immunization of the general population against rabies is NOT warranted. Persons at high risk, such as veterinarians, animal handlers, and certain laboratory workers, should be protected against exposure to rabies by pre-exposure immunization. Otherwise, rabies immunization is administered after exposure.

- The determination of whether to administer vaccine and anti-rabies serum should be made only after examination of the patient, examination of the animal (if possible), and careful evaluation of the circumstances.

- The surgeon of each major command is responsible for establishing a rabies advisory board within his area of medical technical supervision.

-- This board, composed of carefully selected physicians and a veterinarian, must be readily available for consultation to all facilities administering specific anti-rabies prophylaxis.

-- The World Health Organization (WHO) recommends similar boards for civilian communities and facilities.

(2) Local treatment of the bite wound. Treating the bite wound as soon as possible after the bite is probably the most important single procedure in preventing rabies.

- First aid treatment consists in immediately washing and flushing the wound with soap and water, detergent, or water alone. This procedure is recommended in all bite wounds, including those unrelated to possible rabies exposure.

- Following first aid treatment, specific post-exposure treatment should be administered by or under the direction of a physician. This treatment consists of:

-- Adequate cleansing of the wound.

-- Then, thorough treatment of the wound with 20 percent soap solution and/or application of a quaternary ammonium compound or other substance of proven lethal effect on the rabies virus.

-- Topical application and infiltration around the wound of anti-rabies serum.

-- Administration, where indicated, of anti-tetanus procedures and/or antibiotics to control infections other than rabies.

Section IV. ZOONOSES: LEPTOSPIROSIS

7-12. IDENTIFICATION

Leptospirosis is actually a collective term for a group of acute infections caused by many serotypes of the genus *Leptospira* (a spirochete). The disease is also known as Well's disease, infectious jaundice, and Fort Bragg fever.

a. **Reservoirs**. The reservoirs of leptospirosis include cattle, dogs, and swine among domestic animals; and deer, foxes, skunks, raccoons, opossums, reptiles, and rodents among wild animals.

b. **Transmission**. Human infections occur through contact with water or soil contaminated by urine of infected animals, or by direct contact with infected animals.

c. **Occupations Exposed**. The disease is considered an occupational hazard to farmers, sewer workers, veterinarians, and military troops, who live or work in rat-infested areas. Leptospirosis occurs worldwide.

7-13. SIGNS/SYMPTOMS

The incubation period for leptospirosis is from 2 to 20 days. The clinical illness lasts from 1 to 3 weeks and is characterized by headache, severe muscular aches, chills, fever, and conjunctivitis. Infrequently, the patient develops jaundice, renal insufficiency, and hemorrhages in the skin and mucous membranes. Mortality is very low if jaundice does not develop; in the presence of jaundice, however, fatality may reach 15 to 40 percent and is higher among patients over 50 years of age.

7-14. PREVENTIVE MEASURES

Preventive measures against infection include the following:

- Protecting workers in hazardous occupations with boots and gloves
- Educating the public on modes of transmission and on avoiding swimming or wading in potentially contaminated water
- Rodent control in areas of human habitation, especially rural and recreational area (picnic areas; lakes, swimming pools)
- Segregation of domestic animals from living and working areas of man

Section V. IMMUNIZATION

7-15. IMMUNITY AND RESISTANCE

A susceptible or nonimmune has little resistance against a particular disease organism and, if exposed to it, is liable to contract the disease. By contrast, an immune has a high degree of resistance to the organism and, when exposed, does not develop the disease.

a. **Immunity**. While most babies are born with a high level of immunity to many disease organisms, this immunity is lost within a few months. The immunity possessed by adults usually is acquired either naturally or artificially after birth and may be temporary or permanent.

b. **Antibodies**. The basic component of immunity or specific resistance is the antibody. Antibodies are proteins produced by the body system in response to stimulation by a foreign substance (antigen) and having the capacity for combining specifically with that substance. Immunization may be active or passive.

c. **Active Immunization**. In active immunization, antibodies are formed within the body because of the presence of the natural infection (natural immunity) or because of the inoculation into the body of infectious agents or antigenic substances derived there from (artificial immunity).

- In active immunity, a physical change is effected which is relatively slow in developing (10 to 14 days), but whereby a permanent immune pattern is created.

- While the level of active immunity may decline over a period of years, it is susceptible to stimulation and elevation by a relatively small amount of immunizing material.

- The immunizing material comprising the vaccine that is inoculated may be either weakened (attenuated), killed (inactivated) disease organisms, or their products.

d. **Passive immunization**. In passive immunization, antibodies, which have been preformed in humans, are injected into the body of a susceptible.

- The duration of this type of immunity depends upon the persistence of the injected antibodies and is usually not longer than a few weeks.

- While immunity is immediate, no permanent immune pattern is set up.

- Passive immunizations are used primarily in specific emergencies to prevent hepatitis, rabies, measles in contacts, and tetanus in unimmunized wounded individuals.

7-16. TYPES OF VACCINES

a. **Active Immunity**. The Army uses three kinds of vaccines to induce active immunity: attenuated live organisms, inactivated organisms, and products of organisms. The type of vaccine must always be kept in mind when determining how a vaccine will be used, since the responses differ.

(1) Live organisms. Vaccines that consist of suspensions of attenuated (weakened) live organisms -- bacteria or viruses:

- Smallpox.
- Poliomyelitis.
- Yellow fever.
- Measles.
- Mumps.
- Rubella.
- Adenovirus.

A single injection of such a vaccine, properly prepared, stored, and used so that it retains required viability (potency), usually provides a fairly rapid, ample, and lasting immune response.

(2) Inactivated (killed) organisms. Vaccines made from inactivated organisms include:

- Influenza.
- Typhoid fever.
- Cholera.
- Plague.
- Meningococcal.
- Rabies.

A single injection of most inactivated vaccines may produce only a scarcely detectable response.

- The first injection orients the body so that subsequent injections produce successively larger responses.

It is for these reasons that immunization against typhoid fever, cholera, typhus, tetanus, and other diseases for which nonliving vaccines are utilized is carried out by a series of injections.

(3) Products of organisms. Toxoids consist of chemically inactivated bacterial poisons injected into individuals to induce the formation of antibodies against the original bacterial toxin. The two commonly used toxoids are tetanus and diphtheria toxoids.

b. **Passive Immunity**. Passive immunity depends upon the presence of injected, preformed antibodies. The source of such antibodies is serum globulin, a concentrated fraction of blood plasma from human beings. Immune serum globulin (gamma globulin) contains the dominant form of antibodies found in the blood of normal adult human beings. In practice, it has been found to be of value as a prophylaxis against hepatitis, measles, and, in a marginal sense, of poliomyelitis. Immune globulin

preparations for measles, vaccinia, pertussis, mumps, rabies, and tetanus are obtained by hyper- immunization of human beings or from persons with high antibody titers.

7-17. THE ARMY IMMUNIZATION PROGRAM

The primary purpose of the Army Immunization Program is to prevent disease that might interfere with accomplishment of the military mission. Toward this end:

- Standards for handling, storage, and quality control of biological products are set up.

- Immunizations for “routine” and “special” circumstances are selected.

- Dosages and dose intervals are prescribed.

- Measures for control of undesirable side effects are required.

- Appropriate records of immunizations are initiated and maintained.

a. **Standards**. All biologicals obtained in this country for use in the Armed Forces conform to the National Institute of Health requirements for the production and sale of such materials. If procured abroad, these products must conform to standards equivalent to those of NIH.

- Expiration periods are based on previous experience with these or similar agents and studies of the rate at which they lose immunizing potency.

- The immunizing agent may not be used beyond the stated expiration dates without specific authority from The Surgeon General.

- As a general policy, biological products should not be ordered in quantities so great that they will not be used before their date of expiration.

- Yellow fever vaccine must always be shipped and stored at freezing temperatures (below 32° F or 0° C).

- Prolonged storage of poliovirus vaccine should be in the frozen state at a temperature below -5° C or 23° F.

- All other biologicals should be stored at temperatures between 2° and 8°C (35.6° to 46.4°F) and should not be frozen.

b. **Responsibilities.**

- Maintenance of personnel in a current immune status is a command responsibility.

- Unit personnel officers are required to check the immunization status of each person in their units at appropriate intervals.

c. **References**. Technical information pertaining to immunizations, including a list of standard Army stock items of biologicals, may be found in TB MED 114, dated 25 May 1970. Administrative requirements and procedures for implementation of the program are contained in AR 40-562.

NOTE: Because of the nature of immunization requirements and new research data, the information contained in this subcourse is of a general nature and reflects requirements as of this date. For more up-to-date details, the appropriate current publication should be consulted.

7-18. ROUTINE IMMUNIZATIONS

Routine immunizations are those that are routinely administered to all military personnel entering on active duty for periods, in excess of 30 days. Routine immunizations are further categorized according to specific geographical areas of the world in which the prevalence of a particular disease warrants immunization. Routine immunization requirements may be found in AR 40-562.

7-19. SPECIFIC REQUIREMENTS FOR MILITARY PERSONNEL

a. **Adenovirus Types 4 and 7**. Based on the likelihood of transmission, adenovirus types 4 and 7 vaccines are administered orally simultaneously on a one-time basis to recruits.

b. **Cholera**. Cholera vaccine is not administered routinely to either active or reserve component personnel. Cholera vaccine is administered to military personnel, only upon travel or deployment to countries requiring cholera vaccination as a condition for entry or on the direction of the Surgeon General.

c. **Hepatitis A**. Use hepatitis A vaccine and immune globulin (IG) according to ACIP and Service-specific guidance.

d. **Hepatitis B**. Current OSH blood-borne pathogen standards are followed. Current ACIP recommendations are followed regarding the use of HBV vaccine, IG, and hepatitis B immune globulin (HBIG) in the post-exposure prophylaxis of hepatitis B.

e. **Influenza**. The influenza season is defined as extending from October through March in the Northern Hemisphere. Follow this schedule:

(1) Active and reserve military personnel. All active and reserve military personnel entering active duty for periods in excess of 30 days are immunized against influenza soon after entry on duty. An annual immunization against influenza is given, except for those individuals who have received an identical composition vaccine during the preceding 3 months. The annual immunization program commences in October in the U.S., Europe, and the Far East.

(2) Compliance. The Army monitors the compliance with the influenza immunization program. The vaccine is provided to all health care providers and others considered to be at high risk for influenza infection.

f. **Japanese B Encephalitis (JE).** Specific guidance on indications for use and schedule of immunization in military populations is provided by each Service.

g. **Measles, Mumps, and Rubella (MMR).**

(1) Measles and rubella. Measles and rubella are administered to all recruits regardless of prior history. Measles and rubella antibody testing and selective immunization is performed if cost-effective. Single virus vaccines can be used as appropriate, if available.

(2) Mumps. Mumps or MMR vaccine is administered to persons considered to be mumps susceptible. Written documentation of physician diagnosed mumps or a documented history of prior receipt of live virus mumps vaccine or MMR vaccine is adequate evidence of immunity.

(3) Health care workers. All military and civilian personnel engaged in the delivery of health care and having patient contact are appropriately immunized against measles, mumps, and rubella following current ACIP recommendations. Those born before 1957 require laboratory evidence of immunity or written documentation of one dose of measles-containing vaccine after one year of age.

h. **Meningoccus**. Quadrivalent meningococcal vaccine (containing A, C, Y, and W-135 polysaccharide antigens) is administered on a one-time basis to recruits. The vaccine is given as soon as practicable after in-processing or training. This vaccine is required routinely only for recruits, although its use may be indicated in other situations based on transmission potential and risk of contracting meningococcal disease. Service preventive medicine authorities are contacted regarding indications for use beyond the recruit setting.

i. **Plague**. There is no requirement for routine immunization. Plague vaccine is administered to personnel who are likely to be assigned to areas where the risk of endemic transmission or other exposure is high. Vaccine may not be effective in the prevention of airborne infection. The addition of antibiotic prophylaxis is recommended for such situations.

j. **Polio**.

(1) Initial active duty personnel. A single dose of trivalent OPV is administered to all enlisted accessions. Officer candidates, ROTC cadets, and other Reserve Components on initial active duty for training receive a single dose of OPV unless prior booster immunization as an adult is documented.

(2) Booster doses. Booster doses of OPV are not routinely administered, unless individuals are expected to be at exceptionally high risk of exposure to wild poliovirus as a result of international travel. The need for booster doses of OPV is individually determined by the respective attending physicians, based on ACIP recommendations.

(3) Inactivated polio vaccine. Inactivated Polio Vaccine (IPV) is used as an alternative to OPV for selected individuals as clinically indicated in accordance with ACIP recommendations.

k. **Rabies.**

(1) Pre-exposure series. Rabies vaccine is administered to personnel with a high risk of exposure (animal handlers; certain laboratory, field, and security personnel; and personnel frequently exposed to potentially rabid animals in a nonoccupational or recreational setting) in accordance with current ACIP recommendations.

(2) Post-exposure series. Rabies vaccine and rabies immune globulin (RIG) administration will be coordinated with appropriate medical authorities following current ACIP recommendations.

l. **Tetanus--Diphtheria**. A primary series of tetanus-diphtheria (Td) toxoid is initiated for all recruits lacking a reliable history of prior immunization in accordance with existing ACIP guidelines. Individuals with previous history of Td immunization receive a booster dose upon entry to active duty and subsequently in accordance with ACIP requirements.

m. **Typhoid**. Typhoid vaccine is administered to alert forces and personnel deploying to endemic areas. Either oral or intramuscular vaccine is used following current ACIPI recommended dosage schedules.

n. **Yellow Fever**. Yellow fever immunization is required for all alert forces, active duty personnel, or Reserve Components traveling to yellow fever endemic areas.

7-20. CHEMOPROPHYLAXIS

a. **Chemoprophylaxis Requirements**. Command medical officers review indications for use and potential adverse effects of specific chemoprophylactic medications before use.

b. **Current Recommendations**. Current ACIP, or Control of Communicable Disease Manual, recommendations and consultation with the relevant preventive medicine authority are followed for the use of chemoprophylactic agents for the following diseases, which have historically been shown to be of military significance:

- Influenza
- Meningococcal disease
- Leptospirosis
- Plague
- Scrub typhus
- Traveler's diarrhea

c. **Malaria**.

(1) Counseling. Comprehensive counseling on malaria prevention includes mosquito avoidance, personal protective measures (clothing, repellents, bed netting, etc.), and chemoprophylaxis is provided to military and civilian personnel considered at risk of contracting malaria. Specific chemoprophylactic regimens are determined by each of the Services based on degree and length of exposure and the prevalence of drug resistant strains of *Plasmodia* in the area(s) of travel.

(2) Testing. Glucose-6-phosphate dehydrogenase (G6PD) testing should be considered for individuals or units requiring primaquine chemoprophylaxis, especially those of Mediterranean or North African descent. If a G6PD test is obtained, the test result is recorded in the PHS Form 731 and the health record according to Service-specific guidelines.

d. **Group A Streptococcal Disease**. Each military Service develops policies for surveillance and prophylaxis of streptococcal disease at recruit centers.

7-21. BIOLOGICAL WARFARE DEFENSE

a. **Purpose**. DOD Directive 6205.3, DOD Immunization Program for Biological Warfare Defense, establishes policy, assigns responsibilities, and prescribes procedures for members of the DOD against validated biological warfare threats, and prioritization of research, development, testing, acquisition, and stockpiling of biological defense vaccines under Title 10, USC.

b. **Responsibilities**.

- The Commanders of the Unified Commands, annually and as required, provide the Chairman of the Joint Chiefs of Staff with their assessment of the biological warfare threats to their theaters.

- The Chair of the Armed Forces Epidemiological Board, in consultation with the DOD Executive Agent and the Secretaries of the Military Departments, annually

and as required, identify to the Assistant Secretary of Defense/Health Affairs (ASD [HA]) vaccines available to protect against validated biological warfare threat agents and recommend appropriate immunization protocols.

c. **Procedures**. The DOD Immunization Program for Biological Warfare Defense is conducted as follows:

- The Commanders of the Unified Commands provide the Chairman of the Joint Chiefs of Staff with their assessment of the biological warfare threats to their theater.

- The Chairman of the Joint Chiefs of Staff, in consultation with the Commanders of the Unified Commands; the Chiefs of the Military Services; and the Director, DIA, annually validates and prioritizes the biological warfare threats to DOD personnel and forwards them to the DOD Executive Agent through (ASD [HA]).

- Within 30 days of receiving the validated and prioritized biological warfare threat list from the Chairman of the Joint Chiefs of Staff, the DOD Executive Agent, in consultation with the Secretaries of the Military Departments and the Chairman of the Armed Forces Epidemiological Board, provide recommendations to the ASD (HA) on vaccine and immunization protocols necessary to enhance protection against validated biological warfare threat agents.

- Within 30 days of receiving the coordinated recommendations of the DOD Executive Agent, the ASD (HA) directs the Secretaries of the Military Departments to begin immunization of the specified DOD personnel against specific biological warfare threat agents.

7-22. RECORDS FOR MILITARY PERSONNEL

a. **DHHS Form PHS 731**. For each member of the Armed Forces and for nonmilitary personnel, a DHHS Form PHS 731 is prepared. The form contains valid certificates of immunization for international travel and quarantine purposes in accordance with World Health Organization international health regulations. The DHHS Form PHS 731 remains in the custody of the individual who is responsible for its safekeeping and for keeping it in his or her possession when performing international travel.

b. **Issuance of DHHS Form PHS 731 and SF601 to Military Personnel**. At the time of initial immunization of a person entering military service, DHHS Form PHS 731 and SF 601, Health Record--Immunization Record, are initiated. Written statements from civilian physicians attesting to immunization with approved vaccines, and providing dates and dosages, are accepted as evidence of immunization.

Abbreviations & Acronyms

ACIP	U.S. Public Health Service Advisory Committee on Immunization Practices
AR	Army Regulation
ASD (HA)	Assistant Secretary of Defense (Health Affairs)
BUMED	Bureau of Medicine and Surgery
CDC	Centers for Disease Control and Prevention
DHHS	Department of Health and Human Services
DIA	Defense Intelligence Agency
DOD	Department of Defense
FDA	Food and Drug Administration
G6PD	Glucose-6-Phosphate Dehydrogenase
HBIG	Hepatitis B Immune Globulin
HBV	Hepatitis B Virus
HQ	Headquarters
HQDA	Headquarters, Department of the Army
IG	Immune Globulin
IPV	Inactivated Poliovirus Vaccine
JE	Japanese Encephalitis
MMWR	Morbidity and Mortality Weekly Report
MMR	Measles-Mumps-Rubella
MTF	Medical Treatment Facility
OSHA	Occupational Safety and Health Administration
OPV	Oral Polio Vaccine
PHS	U.S. Public Health Service
ROTC	Reserve Officers' Training Corps
SG	Surgeon General
Td	Tetanus-diphtheria Toxoid (adult formulation)

Continue with Exercises

EXERCISES, LESSON 7

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the question, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to “Solutions to Exercises" at the end of the lesson, and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. The virus for hepatitis _____ has been found in all body secretions, but only blood, saliva, semen, and vaginal fluids have been seen to be infectious.

2. List four potential complications of hepatitis B, C, and D.

   a. _____

   b. _____

   c. _____

   d. _____

3. The hepatitis patient has dark urine, clay-colored stools, and an enlarged and tender liver. He is in the _____ phase of hepatitis.

4. a. The agent that causes rabies is a virus that is present in _____ of a rabid animal.

   b. Rabies is transmitted from animal to man when _____ _____.

5. From the site of entry, the rabies virus travels in humans to the _____system and the _____ glands.

6. A person who develops clinical symptoms of rabies can be expected to live:

   a. 24 hours
   b. 3-5 days
   c. About 6 weeks
   d. To a ripe old age

7. The most dangerous stage of rabies in an animal is the:

   a. Prodromal stage
   b. Excitation stage
   c. Paralytic stage

8. In the case of a person bitten by an animal, determination of whether to administer vaccine and anti-rabies serum should be made after:

   a. Examination of the_____.

   b. Examination of the _____.

   c. Careful evaluation of the_____.

9. The most important single procedure in attending an individual who has been bitten by a rabid animal is:

   a. Apprehending the rabid animal
   b. Local treatment of the bite wound
   c. Administration of anti-rabies serum
   d. Comforting the patient

10. Leptospirosis is an occupational disease appearing primarily among:

    a. Sewage workers
    b. Farmers
    c. Soldiers
    d. Veterinarians
    e. All of the above

11. A person who, when exposed to a disease, does not develop the disease is said to be _____.

12. The substance which affords immunity against a disease is known as an _____.

13. When are passive immunizations used?

14. Under what conditions is a soldier required to carry his PHS Form 731 (International Certificates of Vaccination)?

Check Your Answers on Next Page

SOLUTIONS TO EXERCISES, LESSON 7

1. b (table 7-1)

2. a. Chronic disease
   b. Carrier states
   c. Cirrhosis
   d. Liver cancer (para 7-2c(2))

3. Jaundice (para 7-2c(1))

4. a. The saliva
   b. Infected saliva enters a break in the skin. (para 7-9b)

5. Central nervous
   Salivary (para 7-11c)

6. b (para 7-10b)

7. b (para 7-10d)

8. a. The patient
   b. The animal
   c. The circumstances (para 7-11c)

9. b (para 7-11c(2))

10. e (para 7-12c)

11. Immune. (para 7-15)

12. Antibody. (para 7-15b)

13. In specific emergencies to prevent disease (para 7-15d)

14. When performing international travel (para 7-22a)

End of Lesson 7

APPENDIX: FOOD INSPECTION SERVICE GUIDE

1. Personnel.

a. Food handlers' certificates. (AR 40-5)

(1) Have all permanent personnel satisfactorily passed food handler's examinations?

(2) Where are the reports of the examinations maintained?

b. Daily examinations. (AR 40-5)

(1) Are food service personnel examined for evidence of communicable disease each day?

(2) Who makes this inspection among the food service personnel?

(3) Do you see any indications of communicable disease in any of the food handlers?

c. Personal hygiene. (AR 40-5)

(1) Do all personnel have clean hands and nails? Are nails trimmed short?

(2) Do all personnel have properly trimmed hair?

(3) Are all personnel wearing clean clothes?

(4) Do all food-handling personnel wear head covers? Are armpits covered?

(5) Do all personnel wash their hands thoroughly just before coming on duty and after returning from the latrine?

2. General. (AR 40-5, TM 10-405)

a. Insects and rodents. (AR 420-76. TM 5-632)

(1) Is there evidence of flies, rodents, etc.?

(2) Are all measures being taken to keep insect and rodents at a minimum? Ask about the control measure, frequency, cycle, type insecticide (or rodenticide), and method of use.

(3) Are the insect and rodent control measures effective?

(4) Are insecticides or rodenticides present? Are they stored near food?

b. Latrines.

(1) Are there convenient toilet facilities, and are they properly cleaned and maintained?

(2) Is there a sign posted telling all personnel to wash their hands thoroughly before returning to work?

(3) Is hot and cold water furnished?

(4) Are soap, toilet paper, and individual towels provided?

c. Personal belongings.

(1) Are personal belongings in the facility kept to a minimum?

(2) Is there a special and satisfactory place for personal belongings?

d. Rags.

(1) Are rags kept to a minimum?

(2) Are the rags used for cleaning cleaner than the objects being cleaned?

(3) Are all rags washed and dried regularly? Sun-dried preferably?

e. Screens.

(1) Are screen doors self-closing and do they open outward? Are they kept closed?

(2) Are screens clean?

(3) Do screens fit properly and are they in good repair?

f. Windows.

(1) Are all windows clean?

(2) Can adequate dining hail ventilation be effected by opening windows, and are all windows screened?

g. Walls.

(1) Are walls clean and in good repair?

(2) Are fans cleaned regularly?

h. Floors.

(1) Are floors in good repair?

(2) Is the floor cleaned regularly and adequately?

(3) Are there dirt or grease accumulations in corners, around table legs, etc.?

3. Dining hall. (AR 40-5, TM 10-405)

a. Tables.

(1) Are all tables cleaned and washed after each meal?

(2) Are the seats or chairs clean and dry?

b. Condiments.

(1) Are condiment containers kept clean and contents kept fresh?

(2) Are containers greasy or covered with fingerprints?

(3) Are caps and lids of catsup and sauce bottles wiped clean?

c. China and silverware.

(1) Are china and silverware free of grease and food particles?

(2) Is proper disinfections used? (See dishwashing)

(3) Are chipped or cracked china and glassware being used?

(4) Is storage space provided for maximum protection from dust and insects?

(5) Do tray or dish storage racks provide ventilation between individual trays or dishes?

(6) Are shelves and compartments kept clean?

(7) Is silverware dispensed in a sanitary manner?

d. Ice chest.

(1) Is the ice chest clean, covered, and used for ice only?

(2) Is there a proper type drain that does not create a nuisance, nor allow sewage to back up into the chest?

(3) Is the chest located to facilitate easy cleaning in and around it?

(4) Is the ice used in drinks? Does it come in contact with raw foods?

(5) Is it potable ice?

(6) Are scoops, tongs, or other ice-dispensing utensils stored on a clean, dry surface, in a continuously flowing dipper well, in an approved clean sanitized solution, or in the ice with the handle extended out of the ice?

(7) Is glassware used to scoop ice from an ice bin?

e. Water fountain.

(1) Is it free of gum, cigarettes, etc.?

(2) Is the fountain an angle jet type with a protected orifice at least I inch above the fountain rim?

f. Breadbox.

(1) Is it clean, well-ventilated, and insect and rodent proof?

(2) Is it large enough to hold a complete ration of bread and pastry?

4. Kitchen. (AR 420-55)

a. Ranges.

(1) Are ranges kept scrupulously clean and free of food and dirt?

(2) Does range or wall insulation harbor insects?

(3) Are ventilating hoods provided over ranges and griddles?

(4) Is there an accumulation of grease in the range hoods?

b. Worktables.

(1) Are worktables cleaned, rinsed, sanitized after each raw food contact?

(2) Are worktables in good repair?

(3) Are cutting boards used to protect worktable surfaces?

(4) Are the tables badly cut up? Do they have open cracks that harbor food particles and bacteria?

c. Utensils.

(1) Are cooking utensils disinfected by heat or hot water and air-dried?

(2) Are storage shelves, compartments, and utensil racks free of grease, dust, and unnecessary equipment?

(3) Are pots and pans stored in a dry place, bottom up, and not inside one another?

(4) Is an abrasive material used for cleaning plated utensils?

(5) Has plating been worn from inside surfaces of utensils? Is rust evident in worn spots?

(6) Are wood-handled or wood utensils allowed to soak in water? Are they free of cracks or splits that can harbor food and bacteria?

(7) Are knives kept separate from other utensils and in a sanitary rack?

(8) Is overhead storage of sharp or heavy utensils allowed?

(9) Is the potato peeler disassembled and cleaned after each use?

d. Sinks. (AR 420-55)

(1) Are sinks thoroughly cleaned after each use?

(2) Are sinks supplied with drain boards?

(3) Has the galvanized plating been worn off sink surfaces?

(4) Do sinks rust in the worn places between uses?

e. Dishwashing. (AR 40-5/TB MED 530)

(1) Manual.

(a) Are food and grease removed from dishes before the main wash process?

(b) Is the wash water warm enough to facilitate the effectiveness of soap, but not enough to cause scalding, burning, or discomfort to hands?

(c) Are wash and rinse sections kept free of grease during wash and rinse processes?

(d) Are dishes, trays, etc., sanitized by immersing for 30 seconds in water at 170° F (accurate to plus or minus 3° F)? Is the heat controlled by an adequate thermometer?

(e) Are dishes air-dried immediately after disinfection?

(f) Is the handling of dishes after disinfection kept to a minimum?

(2) Dishwashing machines. (AR 40-5)

(a) Does the spray-type or immersion dishwashing machine meet National Sanitation Foundation (NSF) standards?

(b) Are utensils scraped and pre-washed before going into the machine?

(c) Are racks being overloaded with dishes or silverware?

(d) Are dishes placed edgewise in the rack with eating surface up?

(e) Are strainer pans removed and cleaned after each meal?

(f) Are curtains cleaned and air-dried for each meal?

(g) Is the hood left open to allow interior to dry between meals?

(h) Are the wash arms removed and the scale and sediment removed?

(i) Are dishwashing machines operated at proper cycles IAW NSF standards and temperatures? Are there time conveyors to assure proper exposure per manufacturer’s specifications on the machine data plate?

1. Times and temperatures will vary from machine to machine.

2. Single dishwashers.

a. Minimum wash period of 40 seconds at 150° to 160° F.

b. Minimum rinse period of 10 seconds at 180° F.

3. Double tank dishwashers.

a. Minimum wash period of 7 seconds at 150° to 160° F.

b. Minimum final curtain rinse of 180° F for 1 second.

(j) Are thermometers accurate?

(k) Do dishes and silverware air-dry readily?

(l) Are motors and thermometers serviced periodically by the post engineer?

(m) Is steam or hot water leakage creating a safety hazard?

(n) Is the dishwashing machine adequately protected by safety valves and pressure gauges?

(o) Is there a ventilating hood over the machine to carry off hot vapors?

(3) Emergency disinfection.

(a) If hot water is available, is a suitable chlorine solution used for disinfection? Chlorine should be added on the basis of 1 level spoonful (standard mess kit spoon) of high-test calcium hypochlorite per 10 gallons of rinse (good for 40 men), or 1 package of disinfectant chlorine (food service) in 25 gallons (this is normally good for 100 men).

(b) When chlorine is used, are three compartments used?

1. 1st compartment--hot or warm soapy water.

2. 2d compartment--warm (or cool) clear water.

3. 3d compartment--warm (or cool) chlorine rinse.

(c) When using other EPA-registered disinfectants and labeled sanitizers, are manufacturer label instructions followed?

g. Grease Traps (AR 420-49, AR 420-55)

(1) Are grease traps large enough?

(2) Are baffles properly placed?

(3) How often is grease trap skimmed? Scrubbed? Emptied and cleaned?

(4) Do food handlers clean grease traps?

(5) What is done with the grease?

h. Cross-connections. (AR 40-5)

(1) Are any faucets, hose connections, or other water inlets to fixtures below the overflow rim of the sink or fixture? Especially in steam tables and dishwashing machines?

(2) Is there sufficient freefall (broken connection) between the drain lines of coffee urns, dishwashers, steam kettles, or other permanent fixtures and the sewer line?

(3) Are all toilets equipped with siphon breakers?

(4) Do any exposed drain lines or steam lines pass over any food storage or preparation areas?

i. Refrigerators.

(1) Cooling.

(a) Are reach-in refrigerators maintained at or below 40° F (4° C) to ensure stored product temperatures are maintained below 45° F (7° C)?

(b) Are walk-in refrigerators maintained at the appropriate temperature required by the stored product?

(c) Is the refrigerator temperature clearly marked on the outside? (TM 10-401)

(d) Are freezers maintained at an air temperature of 0° F (-17.7° C)?

(e) Do all refrigerated storage areas have a numerically scaled indicating thermometer, accurate to plus or minus 3° F (plus or minus 1.7° F)?

(2) Cleanliness.

(a) Are refrigerators cleaned regularly and adequately?

(3) Arrangements.

(a) Are any leftovers over 24 hours old? Are leftovers of potentially hazardous foods labeled with date and time they were removed from service? (DA label 178, Leftover - Use within 24 hours.)

(b) Is all food (especially fresh meat) properly stored to facilitate proper air circulation, cooling, and cleanliness?

(c) Are foods covered to avoid excessive drying and possible contamination?

(d) Are there any foods present of questionable quality?

(e) Are foods stored above the floor (>6”) on racks, dollies, non-wood pallets, or other easily cleanable surfaces?

(4) Odors.

(a) Does the refrigerator have a musty or rancid odor?

(b) Are deodorants being used to cover up objectionable odors?

(c) Are very odorous foods stored with milk, butter, or other odor-absorbing foods?

(5) Maintenance.

(a) Are coils properly defrosted?

(b) Are the refrigerators inspected periodically by the post engineer?

5. Pantries and storeroom.

a. Cleanliness.

(1) Are they frequently and adequately cleaned?

(2) Are they well lighted and ventilated?

b. Arrangement.

(1) Are foods/food containers stored above the floor (> 6”) on clean racks, dollies, non-wood pallets, or other easily cleanable surfaces?

(2) Does the arrangement facilitate a proper rotation and checking of stocks and cleaning of shelves and storage compartments?

(3) Are insecticides, rodenticides, lye, or other poisons kept in food storerooms?

6. Dining hall area.

a. Drainage.

Has the surrounding area been properly filled or drained to prevent standing water?

b. Mop rack.

(1) Is the mop and broom rack of adequate size and properly constructed?

(2) Is it properly cleaned?

(3) Is the rack properly utilized?

c. Vegetable bin.

(1) Is the bin properly constructed and ventilated?

(2) Is the bin properly utilized and maintained in a clean condition?

(3) Are spoiled vegetables regularly sorted out and discarded?

d. Garbage rack. (AR 40-5)

(1) Is the rack conveniently located/constructed to prevent excessive soil pollution when cleaned?

(2) Is there a building roof or a screened enclosure around or over the garbage rack?

(3) Is the rack frequently and adequately cleaned?

(4) Is the rack area kept cleaned and sprayed to prevent fly breeding?

(5) Is fly breeding present?

e. Garbage cans. (AR 40-5)

(1) Are the cans and lids clean? Are garbage cans cleaned with soap and hot water to maintain sanitary conditions?

(2) Are cans and lids mutually tight-fitting to prevent access to insects and rodents, or are they dented and in poor repair?

(3) Are lids kept closed except when filling or emptying?

(4) Are garbage cans painted or whitewashed?

f. Sorting and handling of garbage and wastes. (AR 420-47)

(1) Are waste materials properly sorted in accordance with existing regulations?

(2) Is the collection cycle satisfactory?

(3) Are materials and wastes, which do not fit in cans neatly, arranged and free of grease and food particles?

(4) Is the handling and care of garbage such that attraction of insects and rodents is kept to a minimum?

(5) Are there enough cans to accommodate the maximum accumulation of garbage -- over weekends, for example?

g. General cleanliness.

Is the surrounding area adequately policed to prevent the accumulation of cigarette butts, peels, and other trash?

h. Insects and rodents. (AR 40-5)

(1) Is there an accumulation of filth and trash, which will attract flies and rodents or provide possible breeding places?

(2) Is there evidence of insects and rodents in the area?

7. Food supplies.

a. General.

(1) Does the food arrive at facility in good condition?

(2) Do perishable foods stand in the kitchen for any length of time before refrigeration?

(3) Are all foods culled and sorted immediately upon receipt and before being stored?

b. Meats.

(1) Was the meat well chilled before delivery?

(2) Is the meat stored promptly after delivery?

(3) Are other foods piled on top of the meat or so placed as to hinder air circulation or cause contamination?

c. Fruits and vegetables.

(1) Are fruits or vegetables bruised, decayed, or insect-eaten?

(2) Are vegetables and fruits readily accessible in order of age?

(3) Are fruits and vegetables so stored as to cause or permit further contamination?

d. Milk.

(1) Is fresh milk stored at a temperature of less than 45° F (7° C)? Whenever feasible, the ideal product temperature is 40° F (4° C) or below.

(2) Is milk served from the original container?

e. Canned food.

(1) Are there any “leakers,” “springers,” or “swellers?”

(2) Are tops of cans cleaned before opening?

8. Food preparation and serving.

a. Preparation.

(1) Are foods removed from refrigerator and allowed to stand too long before using?

(2) Are foods prepared too far ahead of actual serving and not properly refrigerated? (DA Label 177, Prepared Foods)

(3) Are mixtures such as hash, meat loaf, or potato salad combined 3 hours or less before being eaten and kept properly refrigerated in small quantities in shallow vessels until served?

(4) Are proper portions of food prepared? Are large portions held over as leftovers?

b. Serving.

(1) Is food served in such a manner as to keep exposure to a minimum?

(2) Is food served by hand or with a suitable utensil?

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SUBCOURSE MD0152 Diseases of Military Importance EDITION 100

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