Armed Forces Pest Management Board

TECHNICAL INFORMATION MEMORANDUM NO. 41

PROTECTION FROM RODENT-BORNE DISEASES

WITH SPECIAL EMPHASIS ON OCCUPATIONAL EXPOSURE TO HANTAVIRUS

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FOREWORD

This document provides guidance on the protection of individuals from rodent-borne diseases. Information on diseases associated with rodents is presented in tabular form. Rodents may serve as reservoirs for diseases that are transmitted though contact with contaminated food and water by arthropods. Rodents may also transmit diseases through direct contact with humans, such as through bites, or though aerosolization of excreta and body fluids. Prevention of these diseases involves vector control and good sanitation practices. A great amount of literature has been devoted to protection against rodent-associated diseases that are transmitted by vectors or unsanitary conditions. The contents of this manual address the prevention of diseases caused by hantaviruses, which are spread through inhalation or ingestion of materials contaminated with rodent saliva, urine, or feces. Although these diseases are relatively uncommon, the high fatality rate of hantaviruses in the Americas, and the inability to determine from visual observation infected from noninfected rodents, heighten the awareness that must accompany rodents. Because the hantavirus threat was not recognized in 1993, information on rodent hosts and disease distribution, as well as prevention strategies aimed at reducing the incidence of hantavirus pulmonary syndrome, has been limited by time and available technologies. Personal protection measures against hantaviruses are presented for a variety of military situations involving contact with rodents or rodent contamination. Since individuals on military installations may not be able to determine the presence or absence of hantaviruses in every situation involving rodents, the universal use of the precautions in this manual should afford adequate protection.

In light of the current pace of research on rodent-borne diseases, I fully expect that our Board will need to revise this TIM in a short time. Your constructive comments are most welcome and will be given full consideration in the updating of this document.

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Armed Forces Pest Management Board

CHAPTER 1

RODENT-BORNE DISEASES

1. Rodents are involved in the transmission of a variety of diseases found around the world. Although the roles that rodents play in the maintenance and spread of these diseases will vary depending on the disease and the geographic region, certain patterns of involvement emerge.

a. Rodents may serve as intermediate hosts for parasites that ultimately infect man. Although the rodents themselves pose no direct threat to humans, their presence in a geographic region may play a key role in perpetuating infectious organisms that pose a health threat to people in the area. For example, capillariasis, a human liver disease, caused by the adult worm *Capillaria hepatica*, is primarily an infection in rats.

b. Rodents may serve as reservoirs of disease agents (e.g., Lyme disease spirochete, *Borrelia burgdorferi*) that are picked up by arthropod vectors and transmitted to humans through bites. In this case, direct contact with the rodent or its excreta pose no health risk; however, the rodent maintains the disease in the geographic area.

c. Rodents may not only serve as reservoirs but may also play a key role in the transmission of the disease. Hantavirus is a good example of this scenario. There is no vector. The disease agent, a virus, is found in the saliva, urine and feces of the infected rodent. Spread to humans is via inhalation of aerosolized excreta, ingestion of excreta, or by direct contact with the rodent itself.

d. Rodents may directly transmit a pathogen to man through bites, as is the case in rat bite fever.

2. Tables 1-1 and 2-1 list the majority of diseases associated with rodents around the world. These lists are intended to form the basis for further investigation of the risks associated with rodents in areas of the world where US forces may already be located or may be deployed. Further information on rodent-borne or rodent-associated diseases should be sought prior to movement into a given area of the world. Some of the sources listed below should be consulted to broaden knowledge of the health risks associated with rodents.

a. DVEPs - Disease Vector Ecology Profiles, available through the Armed Forces Pest Management Board - DSN 295-7479 or commercial (301) 295-7479.

b. DEARs- Disease and Environmental Alert Reports available through the Armed Forces Medical Intelligence Center.

c. FM 8-33, Control of Communicable Diseases Manual, 16th edition, 1995. This reference may be obtained through military or public health channels.

d. USACHPPM TG No. 103, Prevention and Control of Plague, September 1995.

e. USACHPPM TG No. 138, Guide to Commensal Rodent Control, December 1991.

f. Medical Entomology personnel located within the various services:

(1) The Army Center for Health Promotion and Preventive Medicine, DSN 584-3613 or commercial (410) 671-3613 (http://chppm-www.apgea.army.mil).

(2) The Navy Environmental Health Center (http://www-nehc.med.navy.mil/prevmed) and the Navy Disease Vector Ecology and Control Centers:

(a) NDVECC Jacksonville, FL - DSN 942-2424 or commercial (904) 772-2424.

(b) NDVECC Bangor, WA - DSN 322-4450 or commercial (360) 315-4450.

(3) The Air Force School of Aerospace Medicine, DSN 240-2058 or commercial (210) 536-2058 .

g. The National Centers for Disease Control and Prevention (http://www.cdc.gov):

(1) Atlanta, Georgia - (404) 639-3311.

(2) Fort Collins, Colorado - (970) 221-6400.

h. World Health Organization - WHO Bulletins can be found in most reference libraries or from their webpage (http://www.who.int).

i. State and local health departments - information can usually be obtained by contacting the State Epidemiologist or Vector Control Specialist.

j. National and local health officials in the host country.

Table 1-1. Diseases Associated with Rodents.*

DISEASE	RODENT	TRANSMISSION	REGION
Group C Virus Disease - Apeu, Caraparu, Itaqui, Madrid, Marituba, Marutucu, Nepuyo, Oriboca, Ossa, Restan	Rodents serve as reservoirs	Bite of infective mosquito - *Aedes* and *Culex* (*Melanoconion*)	Tropical South America,Panama, and Trinidad
Omsk Hemorrhagic Fever	Rodents and shrews serve as reservoirs	Bite of infective ticks - *Dermacentor reticulatus* (*pictus*) and *D. marginatus*	Forest steppe region of Siberia, within the Omsk, Novosibirsk, Kurgan and Tjumen regions
Kyasanur Forest Disease	Rodents, shrews and monkeys serve as reservoirs	Bite of infective ticks - esp. *Haemaphysalis* spp.	Kyasanur Forest of the Shimoga and Kanara Districts of Karnataka, India
Babesiosis	Rodents serve as reservoirs for *B. microti*	Bite of nymphal *Ixodes scapularis* ticks that have fed on infected rodents - other *Ixodes* ticks involved in the West	United States - Northeast, Wisconsin, California, Washington, and Mexico
Capillariasis	Primarily found in rats and other rodents	Ingestion of embryonated eggs in soil	North and South America, Turkey, Switzerland, Czechoslovakia, Yugoslavia, Italy, Africa, Hawaii, India, Japan and Korea

DISEASE	RODENT	TRANSMISSION	REGION
Clonorchiasis	Rats serve as reservoirs	Eating raw or undercooked freshwater fish containing encysted larvae	China, Japan, Taiwan, Korea Vietnam, principally in the Mekong River delta
Lassa Fever	Wild rodents; in West Africa, mice in the *Mastomys* species complex	Aerosol or direct contact with excreta of infected rodents	Sierra Leone, Liberia, Guinea and parts of Nigeria
Leishmaniasis	Wild rodents serve as reservoirs	Bite of infective sand flies	Pakistan, India, China, the Middle East, former Soviet Union, Mediterranean littoral, sub-Saharan savanna and Sudan, Ethiopia, Kenya, Namibia, south-central Texas, Mexico, all of Central America, every country in South America except Chile and Uruguay
Lyme Disease	Wild rodents, particularly *Peromyscus* spp.	Bite of infected ticks of the subgenus *Ixodes* of *Ixodes*	Eastern United States, Wisconsin and Minnesota, the West Coast, and Canada. Also found in Europe, the former Soviet Union, China and Japan
Plague	Wild rodents, especially ground squirrels. Commensal rodents will also support outbreaks of plague in urban areas	Bite of infected fleas	Worldwide in semi-arid regions

DISEASE	RODENT	TRANSMISSION	REGION
Rat-Bite Fever	Infected rats, rarely in squirrels, weasels, and gerbils	Transmitted by urine or secretions of the mouth, nose or conjunctival sac of infected rodents, most often through biting	Worldwide, but uncommon in North and South America and most European countries
Relapsing Fever	Wild rodents serve as reservoirs for tickborne relapsing fever	Bite or coxal fluids of infected argasid ticks, principally *Ornithodoros hermsi* and *O. turicata* in the United States, *O. rudis* and *O. talaje* in Central and South America, *O. moubata* and *O. hispanica* in Africa, and *O. tholozani* in the Near and Middle East	Tropical and central Africa, Spain, Saudi Arabia, Iran, India, parts of central Asia, and North and South America
Schistosomiasis	Rodents are potential hosts of *Schistosoma japonica*. *S. malayensis* appears to be a rodent parasite that can infect humans	Infection from water that contains free-swimming larval forms (cercariae) that have developed in snails	China, Taiwan, the Philippines, and Sulawesi
Murine Typhus Fever	Rats, mice, and other small mammals	Infective rat fleas defecate rickettsiae while sucking blood, contaminating the bite site and other fresh skin wounds	Worldwide - found in areas where people and rats occupy the same buildings and where large numbers of mice live

DISEASE	RODENT	TRANSMISSION	REGION
Q Fever	Many species of feral rodents	Airborne dissemination of rickettsiae in dust from premises contaminated by placental tissues, birth fluids, and excreta of infected animals	Worldwide
Sabia (Brazilian) Hemorrhagic Fever	Reservoir is unknown, although rodents are suspected	Inhalation of small particle aerosols derived directly from virus-contaminated rodent excreta and saliva. May be spread by secondary aerosols from farming, by ingestion, or by contact with cuts or abrasions.	Brazil
Junin (Argentinian) Hemorrhagic Fever	Wild rodents, primarily *Calomys musculinus*	Same as above	Argentina
Machupo (Bolivian) Hemorrhagic Fever	The rodent *Calomys callosus* is the reservoir	Same as above	Bolivia
Guanarito (Venezuelan) Hemorrhagic Fever	Cane rats (*Zygodontomys brevicauda*) and cotton rats (*Sigmodon alstoni*) are the reservoirs	Same as above	Venezuela

DISEASE	RODENT	TRANSMISSION	REGION
Colorado Tick Fever	Ground squirrels, chipmunks, and *Peromyscus* spp.	Bite of infective tick, immature *Dermacentor andersoni*	Mountainous regions above 5000 feet in the western United States and Canada
Far Eastern Tickborne Encephalitis, Central European Tickborne Encephalitis, and Powassan Virus Encephalitis	Wild rodents and other animals serve as reservoirs	Bite of an infective tick - *Ixodes persulcatus* in Eastern Russia, *I. ricinus* in western Russia and other parts of Europe, and *I. cookei* in eastern Canada and the United States	Far eastern region of the former Soviet Union, Europe, Canada and the United States
Leptospirosis	Wild rodents, particularly rats	Contact of skin or mucous membranes with water, soil or vegetation contaminated with urine of infected animals; ingestion of food contaminated with urine from infected rats	Worldwide in urban and rural areas except for polar regions
Lymphocytic Choriomeningitis	House mouse, *Mus musculus*	Oral or respiratory contact with virus-contaminated excreta, food or dust; virus shed in mouse urine, saliva, and feces	Americas and Europe
Salmonellosis	Wild rodents	Ingestion of food contaminated by feces of infected animal	Worldwide

DISEASE	RODENT	TRANSMISSION	REGION
American Trypanosomiasis	Numerous wild animals, including rats and mice	Contamination of conjunctiva, mucous membranes, abrasions or skin wounds (including bite site) following bite of infected vector Reduviidae, especially *Triatoma*, *Rhodnius*, and *Panstrongylus*	Western Hemisphere, especially Mexico, Central and South America
Cryptosporidiosis	Guinea pigs, mice, rats, and rabbits	Ingestion of infective sporulated oocysts	Worldwide
Tularemia	Wild rodents	Bite of infected arthropods, including wood ticks, dog ticks, lone star ticks, deer flies, and the mosquito *Aedes cinereus* in Sweden	North America, Europe, former Soviet Union, China, Japan, and Mexico
Yersiniosis	Rodents serve as reservoirs for *Yersinia pseudotuberculosis*	Fecal-oral transmission by eating or drinking contaminated food and water or by direct contact with infected animals	Worldwide; *Y. pseudotuberculosis* is primarily a zoonotic disease with humans as incidental hosts
Rickettsialpox	House mouse	Transmitted by bite of infected mites, *Allodermanyssus sanguineus*	Eastern United States, particularly New York, and the former Soviet Union

DISEASE	RODENT	TRANSMISSION	REGION
Giardiasis	Rodents, as well as other animals	Ingestion of cysts in contaminated water as well as fecal-oral contamination	Worldwide
Pasteurellosis	Mice and rabbits may occasionally be infected	Infection in man is rare, but may be caused by the bite of infected rodents	Worldwide
Toxoplasmosis	Rodents serve as intermediate hosts - definitive hosts are cats and other felines	Ingestion of sporulated oocysts from cat feces; eating undercooked meat containing tissue cysts	Worldwide
Scrub Typhus	Transovarial passage in mites - mites often carried by rodents	Bite of infected larval mites	East and Southeast Asia, North Australia
Rocky Mountain Spotted Fever	Maintained in nature in ticks by transovarial and transstadial passage - ticks often carried by rodents	Bite of infected ticks; in the United States by *Dermacentor variabilis, D. andersoni*, and *Amblyomma americanum*, and in Latin America by *A. cajennense*	United States, Canada, Mexico, Panama, Costa Rica, Colombia, and Brazil

DISEASE	RODENT	TRANSMISSION	REGION
Boutonneuse Fever	Same as RMSF above	Bite of infected ticks; in the Mediterranean area by *Rhipicephalis sanguineus,* and in South Africa by *Haemaphysalis leachi, Amblyomma hebraeum, R. appendiculatus, Boophilus decoloratus,* and *Hyalomma aegyptium*	Africa, Europe, Middle Ease, and Southeast Asia
North Asian Tick Fever	Same as RMSF above	Bite of infected ticks in the genera *Haemaphysalis* and *Dermacentor*	Asiatic areas of the former Soviet Union, China, and Mongolia
Queensland Tick Fever	Same as RMSF above	Bite of infected ticks; *Ixodes holocyclus* is probably the principal vector	Queensland and New South Wales, Australia
Hymenolepiasis	Mice and rats	Ingestion of eggs or infected intermediate hosts (insects) or by fecal-oral contamination	Africa, South America, Caribbean, Italy, Japan, United States, the former Soviet Union
Trichinellosis	Rats and many wild animals	Eating undercooked or raw meat containing encysted larvae	Worldwide

* Hantaviruses are also associated with rodents, but, due to the volume of information, are not included in this table. See Chapter 2 (Table 2-1) for more information on hantaviruses.

CHAPTER 2

ABOUT HANTAVIRUSES

1. There are two types of hantaviruses. One group of hantaviruses causes hemorrhagic fever with renal syndrome (HFRS), while another group causes hantavirus pulmonary syndrome (HPS). Information on hantaviruses can be found in Table 2-1.

a. Hemorrhagic fever with renal syndrome is mostly associated with human cases in Europe and Asia (Korean hemorrhagic fever). As the name implies, the kidneys are the primary target of these viruses. The hantaviruses that cause this disease have been known for some time. This disease is usually not life-threatening (fatality rate > 5 percent) but can cause severe illness for up to several weeks, with convalescence from weeks to months. The reservoirs are usually field rodents, with the exception of Seoul virus, which is transmitted by domestic rats. Seoul virus is also found in the United States, but is usually less severe than in other parts of the world.

b. Hantavirus pulmonary syndrome is an acute viral disease that primarily affects the lungs. The illness, which can cause severe respiratory failure and cardiogenic shock, has a fatality rate of approximately 50 percent. Unlike HFRS, however, recovery from HPS is rapid with full restoration of lung function. HPS does not appear to be limited to a particular age, race, ethnic group, or gender. The chance of exposure to hantavirus is greatest when individuals work, play, or live in closed spaces where there is an active rodent infestation. It is important to be aware of possible rodent exposure, for example, when working in buildings or other structures that have been closed for extended periods of time, or when opening or working with pieces of equipment that may be infested by rodents.

2. The following Summary of Known and Proposed Hantaviruses (Bunyaviridae: *Hantavirus*) was provided via electronic message by Charles H. Calisher, Ph.D., AIDL, Department of Microbiology, Colorado State University, Fort Collins, Colorado, on November 26, 1996.

a. Before the 1993 outbreak of hantavirus pulmonary syndrome in the United States, the genus *Hantavirus* consisted of the following distinct viral species: Hantaan, Puumala, Seoul, and Prospect Hill. Dobrava-Belgrade virus was under investigation as a possible fifth serotype. One limiting factor in the recognition of new members of the genus has been the relative difficulty of their primary *in vitro* cultivation.

b. The HPS outbreak investigation made extensive use of genetic methods that led to the recognition of the etiologic agent, Sin Nombre virus (SN), well before SN was propagated in cell cultures. The successes of RT-PCR in the rapid detection and genetic characterization of SN, as well as the development of diagnostic antigens through recombinant DNA expression of SN genes, has encouraged the widespread adaptation of these methods to the study of other

hantaviruses. As a consequence, the pace of discovery of new hantaviruses has greatly accelerated since 1993. A number of new hantaviruses are known only genetically, while others have been subjected to serologic comparisons with previous serotypes using either tissue culture-adapted isolates or recombinant DNA methodologies.

c. Each hantavirus appears to be closely adapted to a single predominant rodent host. This observation suggests an ancient relationship between virus and host. In most instances, the virus has not been proved to be present throughout the host's entire range. For many hantaviruses, there are well-documented examples of a rodent other than that listed (Table 2-1) playing an important, even predominant, carrier role. For example, *Microtus rossiaemeridionalis* may play a role in maintenance of Tula virus in some settings, and *Peromyscus leucopus* and *P. boylii* can be important reservoirs for SN. There are also many examples of occasional "spillover" of viruses into hosts separated from the predominant carrier at the generic, familial or higher level, but these events are considered by some to be of little epidemiologic or evolutionary importance.

d. All hantaviruses except Thottapalayam (TPM) have been isolated or detected in murid rodents. Because TPM virus was isolated on only a single occasion from a shrew (Order Insectivora), the host assignment must be considered tentative.

3. Between May 1993 and March 1999, there were 209 cases of hantavirus reported in the United States, with death resulting in 89 cases, approximately 43 percent. Of these 209 cases, 39 were identified retrospectively prior to the initial outbreak of hantavirus in the Four Corners area of the southwest in 1993.

4. American hantaviruses are newly recognized, not newly emerging. Several factors indicate that these viruses have been in the Americas for thousands of years:

a. The viruses seem to cause no pathology in their rodent hosts, indicating that the virus-host relationship has been ongoing for a long period of time.

b. The viruses are passed from rodent to rodent by contact (i.e., kissing, fighting, grooming, exposure to urine and feces, and mating). Because no arthropod vector has been found, the spread of these diseases across extensive geographic areas probably took a long time.

c. There are many different types of hantaviruses found in many different species of rodents. This genetic divergence within the virus group and rodent populations also took considerable time to develop.

5. This picture of virus-host relationships indicates that the exposure of people in the Americas to New World hantaviruses has been ongoing for centuries. Until 1993, deaths from these diseases were attributed to other causes, usually pneumonia since the lungs are involved. There does appear to be some indication that hantaviruses have proliferated in certain geographic regions for short periods of time. This may be due to environmental conditions that allow wild rodents harboring the viruses to

"explode" in numbers, thus increasing the exposure of people to rodents and their excreta. The majority of human cases of hantavirus in the United States have been caused by SN. Following the initial discovery of SN in 1993, other hantaviruses have been found in this country that cause disease in people.

a. Another hantavirus that has been confirmed to be pathogenic to humans is Bayou virus (BAY), which has been found in *Oryzomys palustris,* the rice rat. Three cases of hantavirus have been confirmed to have been caused by Bayou virus by analyzing human sera. This virus can be fatal.

b. New York virus (NY) causes HPS and has resulted in fatality in several cases. The white-footed mouse, *Peromyscus leucopus,* is thought to be the primary reservoir. This virus closely resembles SN.

c. Black Creek Canal virus (BCC), found in cotton rats, *Sigmodon hispidus,* has caused illness in one human case. Although the patient survived, there is no evidence that subsequent cases of BCC will not be fatal.

d. Other hantaviruses have been found in rodents, but not in humans. It may be that these viruses do not cause illness in people, as in the case of Prospect Hill virus (PH), or it may be that conditions for human infection have not been favorable.

7. Rodents are the primary reservoir hosts of the recognized hantaviruses. Each hantavirus appears to have a preferred rodent host, but other small mammals can be infected as well.
Rodents in the genus *Peromyscus* have been especially targeted for capture and processing during field surveys conducted by local, state, and federal health agencies because of this genus' involvement in hantavirus in the Four Corners Area of the Southwest during the last four years. *Peromyscus maniculatus,* the deer mouse, has been implicated as the primary reservoir for SN.

8. Hantaviruses do not cause obvious illness in their rodent hosts. Infected rodents shed virus in saliva, urine, and feces for many weeks, but the duration and period of maximum infectivity are unknown.

9. Human infection may occur when infective saliva or excreta are inhaled as aerosols. Transmission may also occur when fresh or dried materials contaminated by rodent excreta are disturbed, introduced into broken skin or the eyes, or, possibly, ingested in contaminated food or water. Persons have also become infected after being bitten by rodents.

10. Ticks, fleas, mosquitoes and other biting insects are not known to have a role in transmission of hantaviruses. Person-to-person transmission has not been associated with any of the previously identified hantaviruses or with the recent outbreak in the southwestern United States;

however, such transmission is being evaluated in South America. Cats and dogs are not known to be reservoirs of hantaviruses in the United States, but these animals may bring infected rodents into contact with humans.

11. Travel to and within all areas where hantavirus infection has been reported is safe. The possibility of exposure to hantavirus for campers, hikers, and tourists is very small and reduced even more if steps are taken to minimize rodent contact.

12. Hantaviruses have lipid envelopes that are susceptible to most disinfectants (e.g., dilute hypochlorite solutions, detergents, ethyl alcohol, or most general-purpose household disinfectants). How long these viruses survive after being shed in the environment is uncertain. However, ultraviolet light (sunlight) has been shown to inactivate hantaviruses.

13. One hundred and seventy human cases in four years is not a great number. However, the high fatality rate is ample reason for concern. Because we now know the source of hantavirus infection (breathing or ingesting virus-contaminated feces, urine or saliva), it is prudent to assume a "worst case scenario" when dealing with wild rodents or rodent-contaminated buildings. Specific information on various groups of people occupationally or recreationally exposed to rodents associated with hantaviruses will be discussed in other chapters in this manual.

Table 2-1. Hantaviruses.[1]

Species	Disease	Principal Reservoir	Distribution of Virus	Distribution of Reservoir
Hantaan (HTN)	HFRS[a]	*Apodemus agrarius* (striped field mouse)	China, Russia, Korea	C Europe south to Thrace, Caucasus, and Tien Shan Mtns; Amur River through Korea to E Xizang and E Yunnan, W Sichuan, Fujian, and Taiwan (China)
Dobrava/ Belgrade (DOB)	HFRS	*Apodemus flavicollis* (yellow-neck mouse)	Balkans	England and Wales, from NW Spain, France, S Scandinavia through European Russia to Urals, S Italy, the Balkans, Syria, Lebanon, and Israel
Seoul (SEO)	HFRS	*Rattus norvegicus* (Norway rat)	Worldwide	Worldwide
Puumala (PUU)	HFRS	*Clethrionomys glareolus* (bank vole)	Europe, Russia, Scandinavia	Palearctic from France and Scandinavia to Lake Baikal, south to N Spain, N Italy, Balkans, Altai and Sayan Mtns; Britain and SW Ireland
Thailand (THAI)	nd[b]	*Bandicota indica* (bandicoot rat)	Thailand	Sri Lanka, peninsular India to Nepal, Burma, NE India, S China, Laos, Taiwan, Thailand, Vietnam
Prospect Hill (PH)	nd	*Microtus pennsylvanicus* (meadow vole)	United States, Canada	C Alaska to Labrador, Newfoundland and Prince Edward Island, Canada; Rocky Mountains to N New Mexico, in Great Plains to N Kansas, and in Appalachians to N Georgia, USA
Khabarovsk (KBR)	nd	*Microtus fortis* (reed vole)	Russia	Transbaikalia Amur region; E China

Species	Disease	Principal Rerservoir	Distribution of Virus	Distribution of Reservoir
Thottapalayam (TPM)	nd	*Suncus murinus* (musk shrew)	India	Afghanistan, Pakistan, India, Sri Lanka, Nepal, Bhutan, Burma, China, Taiwan, Japan, Indomalayan region
Tula (TUL)	nd	*Microtus arvalis* (European common vole)	Europe	Throughout Europe to Black Sea and NE to Kirov region, Russia
Sin Nombre (SN)	HPS[c]	*Peromyscus maniculatus* (deer mouse)	United States	Alaska panhandle across N Canada, south through most of continental USA, excluding SE and E seaboard, to southernmost Baja California Sur and to NC Oaxaca, Mexico
New York (NY)	HPS	*Peromyscus leucopus* (white-footed mouse)	United States	C and E USA to S Alberta and S Ontario, Quebec and Nova Scotia, Canada; to N Durango and along Caribbean coast to Isthmus of Tehuantepec and Yucatan Peninsula, Mexico
Black Creek Canal (BCC)	HPS	*Sigmodon hispidus* (cotton rat)	United States	SE USA, from S Nebraska to C Virginia south to SE Arizona and peninsular Florida; interior and E Mexico through Middle America to C Panama; in South America to N Colombia and N Venezuela
El Moro Canyon (ELMC)[d]	nd	*Reithrodontomys megalotis* (Western harvest mouse)	United States, Mexico	SC British Columbia and SE Alberta, Canada; W and NC USA, S to N Baja California and interior Mexico to central Oaxaca

Probable Species[e]	**Disease**	**Principal Rerservoir**	**Distribution of Virus**	**Distribution of Reservoir**
Bayou (BAY)[d]	HPS	*Oryzomys palustris* (rice rat)	United States	SE Kansas to E Texas, eastward to S New Jersey and peninsular Florida
Topografov (TOP)	nd	*Lemmus sibiricus* (Siberian lemming)	Siberia	Palearctic, from White Sea, W Russia, to Chukotski Peninsula, NE Siberia, and Kamchatka; Nearctic, from W Alaska E to Baffin Is and Hudson Bay, S in Rocky Mtns to C British Columbia, Canada
Andes (AND)[d]	HPS	*Oligoryzomys longicaudatus*[f] (long-tailed pygmy rice rat)	Argentina	NC to S Andes, approximately to 50 deg S latitude, in Chile and Argentina
To be named[d]	HPS	*Calomys laucha* (vesper mouse)	Paraguay	N Argentina and Uruguay, SE Bolivia, W Paraguay, and WC Brazil
Isla Vista (ISLA)[d]	nd	*Microtus californicus* (California vole)	United States	Pacific Coast, from SW Oregon through California, USA, to N Baja California, Mexico
Bloodland Lake (BLL)[d]	nd	*Microtus ochrogaster* (prairie vole)	United States	N and C Great Plains, EC Alberta to S Manitoba, Canada, S to N Oklahoma and Arkansas, E to C Tennessee and W West Virginia, USA; relict populations elsewhere in USA and Mexico
Muleshoe (MUL)[d]	nd	*Sigmodon hispidus* (cotton rat)	United States	SE USA, from S Nebraska to C Virginia south to SE Arizona and peninsular Flrorida; interior and E Mexico through Middle America to C Panama; in South America to N Colombia and N Venezuela

Probable Species[e]	**Disease**	**Principal Rerservoir**	**Distribution of Virus**	**Distribution of Reservoir**
Rio Segundo (RIOS)[d]	nd	*Reithrodontomys mexicanus* (Mexican harvest mouse)	Costa Rica	S Tamaulipas and WC Michoacan, Mexico, S through Middle American highlands to W Panama; Andes to W Colombia and N Ecuador
Rio Mamore (RIOM)[d]	nd	*Oligoryzomys microtis* (small-eared pygmy rice rat)	Bolivia	C Brazil south of Rios Solimoes-Amazon and contiguous lowlands of Peru, Bolivia, Paraguay, and Argentina

[1] Reprinted with permission of the authors: Connie Schmaljohn and Brian Hjelle. Hantaviruses: A Global Disease Problem. Emerging Infections Diseases, vol 3, no. 2, April-June 1997.

[a] HFRS, hemorrhagic fever with renal syndrome

[b] nd, none documented

[c] HPS, hantavirus pulmonary syndrome

[d] not yet isolated in cell culture

[e] viruses for which incomplete characterization is available, but for which there is no clear evidence indicating that they are unique

[f] suspected host, but not confirmed

CHAPTER 3

HANTAVIRUS RISK REDUCTION

1. The percentage of hantavirus-positive rodents from a given trapping location may not represent the entire area. Geographic areas within the Southwest have shown hantavirus infection rates in certain populations of *P. maniculatus* to be as high as 70 percent. However, the number of positive or negative rodents may vary from location to location, from species to species, and from one time of year to another.

2. Public education and awareness about hantavirus are the best methods of protection. All personnel potentially exposed to rodent droppings or urine should be aware of the possibility of acquiring hantavirus. Building surveys should be performed on a regular basis, and any indication of rodent activity should be addressed on every occasion. When controlling rodents, pay special attention to the following suggestions.

a. Rodent infestations in bunkers, warehouses, and outbuildings can be controlled by the use of snap traps, glue boards, and poison bait. Detailed information on commensal rodent control is outlined in U.S. Army Environmental Hygiene Agency Technical Guide 138, Commensal Rodent Control (Reference 3).

b. Preventive control is a very important aspect of rodent management. All buildings should be rodent-proofed, if possible.

c. Sanitation practices are essential in deterring rodents from entering buildings. All sources of food and water for rodents should be eliminated.

3. Rodent surveillance should be conducted before occupying any infrequently used buildings. These buildings should first be aired out. Inspections of equipment and supplies stored in the buildings should also be done prior to use of any materials. Occupied buildings should be inspected on a regular basis for evidence of rodent activity or infestations and any personnel noting rodent activity should report it to the proper authorities.

4. Almost every case of hantavirus can be traced to direct contact with rodents or contact with rodent infestations in enclosed buildings. Rodent urine and feces seem to pose the greatest health risk to people. Risk is increased when rodent droppings or urine are aerosolized in enclosed spaces such as buildings, bunkers, and warehouses. Personnel moving equipment, cleaning buildings, or otherwise disturbing deposited urine or feces may be at risk if not adequately protected. Areas with evidence of rodent infestations should be thoroughly disinfected and cleaned to reduce the likelihood of exposure to hantavirus-infected materials.
Direct contact with rodent droppings may also be a means of transmitting the virus to humans.

Cleanup procedures should be performed in a manner that limits the potential for aerosolization of rodent-contaminated material (droppings, urine, or nests). Anyone involved in cleaning rodent-infested buildings or handling dead rodents should use proper procedures.

5. Personnel training, working, or participating in events outdoors appear to be at a significantly lower risk of acquiring hantavirus infection than personnel exposed to rodent droppings or urine indoors. Lower risks of acquiring hantavirus outdoors as opposed to indoors are due to a number of factors:

a. Infected rodent excreta is less concentrated outdoors.

b. Winds will dissipate any aerosolized virus.

c. Direct sunlight will destroy any viable hantavirus when it is exposed for approximately 30 minutes.

d. The density of field rodents outdoors is much less than that encountered indoors.

People who can be considered at a higher risk might include pest controllers, wildlife biologists, contractors, plumbers, electricians, carpenters, maintenance workers, building inspectors, and workers involved in demolition or cleaning of old buildings.

6. Personnel tasked with inspection and cleanup of rodent contaminated buildings and other personnel identified as being at risk of acquiring hantavirus infection should be well instructed in preventive measures, symptoms of the disease, and when to seek medical attention. A medical surveillance program for all people routinely exposed to rodents should include a medical history, a physical examination with attention to the pulmonary and renal systems, medical clearance for respirator use, and baseline blood tests. A baseline serum sample for each worker at risk, drawn in a red-top tube, should be Aon hold@ and stored frozen (at -20 o C) for future analysis in the event it is needed.

7. To minimize the risk of hantavirus infection, personal protective equipment should be worn by those exposed to field rodents or their droppings/urine. This equipment should include respirators with high-efficiency particulate air (HEPA) filters, goggles, solvent-resistant gloves, coveralls, and boots. Detailed guidance on personal protection for various classes of potentially exposed individuals against hantavirus infection was published by the Centers for Disease Control and Prevention as a special report in the Morbidity and Mortality Weekly Report (Reference 5). Appendix B lists the respirators and HEPA filters available through the Paperless Order Placement System (POPS). Table 3-1 provides a quick guide to personal protection against hantavirus infection for various classes of individuals and the tasks they perform on military installations that may bring them into contact with rodents or rodent-contaminated areas. Additional information on personal protective equipment for various individuals exposed to rodents or rodent-contaminated buildings can be found in Chapters 5-9, this guide.

Table 3-1. Quick Guide to Personal Protection for Individuals When Rodents or Rodent Contaminants are Present.

INDIVIDUALS INVOLVED	TASK/ACTIVITY	PERSONAL PROTECTIVE EQUIPMENT	REFERENCE
Hikers, Campers, Soldiers, other Recreational Users	Outdoor activities	None	Chapter 4
Hikers, Campers, Soldiers, other Recreational Users	Indoor activities - initial entry into building or structure	Leave building immediately if rodents/contamination found	Chapter 4
Hikers, Campers, Soldiers, other Recreational Users	Indoor activities - activities require presence in rodent-contaminated building	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter	Chapters 6, 7 and 9
Family Housing Residents	Dispose of rodents and traps	Plastic gloves, plastic bags, and disinfectant	Chapter 5
Pest Controllers	Dispose of rodents and traps (cantonment area)	Plastic gloves, plastic bags, and disinfectant	Chapter 5
Plumbers, Electricians and other Occupational Workers	Infrequent rodent contact in or under buildings and structures	Coveralls, work boots or shoes, plastic gloves, goggles (when in confined spaces) -- respirator with HEPA filter if signs of rodents/contamination are present	Chapter 6

INDIVIDUALS INVOLVED	TASK/ACTIVITY	PERSONAL PROTECTIVE EQUIPMENT	REFERENCE
Pest Controllers or other Special Detail Personnel	Clean up rodent-contaminated buildings and structures	Coveralls or surgical scrubs, surgical gown, plastic apron, two pairs of surgical gloves, boot covers, PAPR	Chapters 7 and 9
Medical Personnel, Pest Controllers, Range Control or others	Inspect buildings for rodents or rodent contamination	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter	Chapters 6, 7 and 9
Medical Personnel (including field soldiers), Mammalogists, Wildlife Biologists, or others	Collecting rodent traps	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter; soldiers can wear M-40 mask as respirator	Chapters 8 and 9
Medical Personnel (including field soldiers), Mammalogists, Wildlife Biologists or others	Handling and processing rodents	Coveralls or surgical scrubs, surgical gown, plastic apron, two pairs of surgical gloves, boot covers, PAPR; soldiers can wear MOPP Level 4 in lieu of above	Chapters 8 and 9

CHAPTER 4

PRECAUTIONS FOR PERSONNEL CAMPING, HIKING, OR CONDUCTING OTHER OUTDOOR ACTIVITIES

1. Individuals on military installations may participate in a variety of outdoor activities where rodents are present. The risk of acquiring hantavirus outdoors is greatly reduced compared to entering rodent-contaminated buildings or structures. However, since some contact with rodents may occur outdoors, the following precautions, recommended by CDC (see Reference 5 for additional information), should be taken:

a. Avoid coming in contact with rodents and rodent burrows or disturbing dens (such as pack rat nests).

b. Do not use cabins or other enclosed shelters that are rodent infested until they have been appropriately cleaned and disinfected (this includes field latrines that are used infrequently or seasonally). See Chapter 7 for cleanup procedures.

c. Do not pitch tents or place sleeping bags in areas near rodent feces or burrows or near possible rodent shelters (e.g., garbage dumps or woodpiles).

d. If possible, do not sleep on the bare ground. Use a cot with a sleeping surface at least 12 inches above the ground. Use tents with floors.

e. Keep food in rodent-proof containers.

f. Promptly bury (or--preferably--burn and bury, when in accordance with local requirements) all garbage and trash, or discard in covered trash containers.

g. Use only bottled water or water that has been disinfected by filtration, boiling, chlorination, or iodination for drinking, cooking, washing dishes, and brushing teeth.

2. Soldiers bivouacking in the field are at minimal risk if the procedures listed above are followed. However, if soldiers are required to use seasonal buildings or shelters, then an initial inspection for rodents or signs of rodent contamination should be made before troops enter and begin to disturb dust and furnishings inside. Care must also be taken when entering bunkers, sheds or other structures that are infrequently used. If evidence of rodents (live or dead animals, droppings, urine or nesting material) is found inside the building, then entry and use should be prohibited until rodent contamination is removed or personnel wear equipment that protects them against hantavirus infection.

3. Individuals using horse stables should be at low risk of acquiring hantavirus. Rodents that carry hantavirus are usually not found in large numbers in stalls where horses are kept, but

significant numbers of rodents may be encountered in barns, feed bins, or other structures in and around the stables. If rodent contamination is encountered, adequate precautions should be taken to limit access to the contaminated areas until proper inspection, cleanup and decontamination can be performed (see Chapters 6, 7 and 9).

CHAPTER 5

DECONTAMINATION OF TRAPS AND DISPOSAL OF DEAD RODENTS

1. Mammalogists, pest controllers, and other individuals on installations may occasionally have to dispose of dead rodents and decontaminate rodent traps. The following procedures should be followed:

a. All individuals handling rodents or traps should wear impermeable, washable gloves.

b. Dispose of dead rodents by picking up the trap with rubber or plastic gloves, placing the carcasses in a plastic bag containing sufficient general-purpose household disinfectant to thoroughly wet the carcasses. The disinfectant may be sprayed into the bag or liquid may be added. Seal the bag and then dispose of it as permitted by local regulations. Three tablespoons of household bleach in one gallon of water may be used in place of a commercial disinfectant.

c. Traps contaminated by rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or bleach solution. The trap may be sprayed in place, decontaminated in the bag with the rodent, or treated separately after the rodent is removed.

2. Family housing occupants may also encounter dead rodents in traps that they have set. The procedures listed above are recommended when handling rodents in traps. However, the following procedures may be used when house mice (not deer mice or other field rodents) are involved, particularly in areas of the country where hantavirus has not been found.

a. A plastic bag, inverted over the hand, can be used to pick up a trap with rodent, or a rodent-contaminated trap without a rodent. After grasping the trap with the plastic-protected hand, the rest of the bag is then pulled over the hand and the trap. The inside of the bag, as well as the rodent and trap, should be sprayed with a disinfectant as described above.

NOTE: The majority of rodents captured in buildings in the cantonment area will be house mice. Since these rodents are not associated with hantaviruses that infect people, special respirators and more expensive personal protective equipment, mentioned in various chapters in this guide, are not recommended. In some cases, pest controllers and family housing residents may trap field rodents that enter their homes. Keep rodents and traps away from the face when following these procedures. Keep rodents and traps downwind when working outdoors or when there is an air current indoors (e.g., fan, air conditioner). The procedures mentioned above should be sufficient for occasional disposal of rodents that may carry hantavirus. However, if several field rodents are captured, or if signs indicate that an ongoing rodent infestation is present, then rodent trapping and disposal should be performed by a knowledgeable pest controller wearing higher-level protective clothing and equipment. A family housing unit heavily infested with field rodents should be treated the same as other rodent-contaminated buildings (see Chapter 7).

b. The bag should be sealed with the zip lock or a twist tie, rolled up in newspaper, and placed in the local trash receptacle.

c. Hands should be thoroughly washed with soap and water.

3. Whenever captured rodents are to be used for scientific investigation (e.g., hantavirus detection), disinfecting the rodent carcasses may interfere with subsequent analytical procedures. Dead rodents should be placed in sealable (e.g., ziplock) bags that are then placed in another container (e.g., ice chest or cooler). When the rodent processing is completed, then the outer surfaces of the container should be sprayed or wiped down with disinfectant. The inner surfaces of the container should not be sprayed with disinfectant -- the rodents are considered contaminated and should not be sprayed with anything (disinfectant) that could alter the ability to extract viruses at a later date. The container should be opened inside a bio-hood and handled by personnel wearing appropriate protective equipment. When the container is no longer needed, the inside should be disinfected. Care should be taken to prevent unauthorized personnel from opening the container. More detailed information concerning field processing of rodents can be found in Chapter 8.

NOTE: Traps that contain live rodents will be decontaminated within the perimeter of the rodent processing site (see chapter 9). Rodents caught in snap traps or glue boards should be sprayed with disinfectant at the trap site before being removed from buildings. Appropriate personal protective clothing and equipment should be worn whenever rodents and rodent-contaminated traps are handled. Information on additional protection can be found in Chapters 6-9.

CHAPTER 6

PROTECTION FOR PERSONNEL INSPECTING OR WORKING IN RODENT-CONTAMINATED BUILDINGS AND STRUCTURES

1. Many rodents naturally seek food and shelter in buildings and other structures on military installations. Available food is always an attractant, whether the building is occupied or vacant. Frequently used buildings on the cantonment, such as offices, clinics and hospitals, and other administrative facilities, are usually infested with commensal rodents, primarily the house mouse, *Mus musculus*, and/or the Norway rat, *Rattus norvegicus*. Neither of these two species has been implicated as a reservoir of hantaviruses causing Hantavirus Pulmonary Syndrome in the United States, but Norway rats may serve as reservoirs of Seoul virus, both in CONUS and in overseas areas. Warehouses, bunkers, and other storage facilities may be subject to infestation by both commensal and field rodents. Because it is not always possible for workers to determine which species of rodents are infesting buildings and structures, certain precautions should be taken to prevent hantavirus infection.

2. Some occupational workers on the installation may infrequently come in contact with rodent-contaminated buildings or structures. Most such contact will be incidental but, occasionally, heavily-contaminated areas may be encountered. If visible signs of rodent infestations are present (droppings, dead rodents, nesting materials), then the worker should leave the building and request that an inspection team evaluate the contaminated site.

a. Workers should be informed about the symptoms of hantavirus and be given detailed guidance on preventive measures. Information should include how to recognize rodent infestations or contamination.

b. Workers who develop a febrile or respiratory illness within 45 days of the last exposure to rodent-infested or contaminated areas should seek medical attention immediately and inform the attending physician of the potential occupational risk of hantavirus infection.

c. The following personal protective measures should be taken:

(1) Coveralls, work shoes or boots, and gloves should always be worn, not only to protect the individual from rodent contamination, but from other environmental contaminants as well.

(2) If working in confined spaces (e.g., crawl spaces under buildings), goggles should be worn.

(3) If there are signs of rodents, and the work to be performed in the building cannot be postponed for proper inspection and decontamination, then respirators fitted with HEPA filters should be worn.

(4) Adequate handwashing facilities should be provided at the site, especially if rodent-contaminated dust and soil are encountered.

NOTE. The procedures listed above are for situations where contact with rodents is infrequent or light rodent contamination is encountered. Degrees of contamination are often difficult to determine since there are no standards by which to judge. Light contamination may mean several rodent droppings, whereas heavy contamination may be characterized by the presence of rodent droppings throughout the facility. If the level of contamination is unclear, then the procedures described below should be followed.

3. Certain installation personnel may be tasked with inspecting buildings for rodent contamination. Medical personnel and pest controllers may be requested to perform inspections following complaints from workers or building managers who have encountered rodents. Personnel from other directorates (e.g., Public Works, Range Control) may be detailed to inspect infrequently used buildings or buildings that are going to be demolished. These individuals may be at higher risk than occupational workers, who may infrequently encounter rodent-contaminated buildings. The following procedures should be adopted by those individuals who perform rodent inspections.

a. A baseline serum sample, preferably drawn at the time of employment, should be available from all persons whose occupations involve frequent rodent contact. The serum sample should be stored at -20^{o}C.

b. Workers in potentially high-risk settings should be informed about the symptoms of hantavirus and given detailed guidance on preventive measures. Information should include how to recognize rodent infestations or contamination.

c. Workers who develop a febrile or respiratory illness within 45 days of the last exposure to rodent-infested or contaminated areas should seek medical attention immediately and inform the attending physician of the potential occupational risk of hantavirus infection.

d. The minimum personal protective equipment should include:

(1) Coveralls.

(2) Gloves. Either disposable or cleanable, reusable (e.g., nitrile). Cloth or leather gloves should not be worn since they are difficult to decontaminate.

(3) Goggles. These afford eye protection from direct contact with rodent-contaminated soil or dust or from gloved hands that have handled rodent-contaminated materials.

(4) Work boots or shoes.

(5) Half or full-face respirator with HEPA cartridges. This device protects against breathing aerosolized rodent urine or fecal particles containing virus and also provides protection of the mouth and nose from gloved hands that have handled rodent-contaminated materials.

e. All individuals who are required to wear a respirator must be evaluated and fit-tested by their appropriate medical authority. Respirators that require fit-testing (i.e., those that have a tight seal around the respirator edges) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirators that rely on positive pressure for protection (e.g., PAPR - Powered Air Purifying Respirator) can be worn by individuals with or without facial hair. In fact, if the individual will be wearing a respirator for a prolonged period of time (e.g., more than one hour), then a positive pressure type device may be more comfortable since it provides a flow of air across the face. This is particularly desirable under hot conditions. An added feature of a PAPR is that it accommodates wearing glasses under the device.

f. Provisions should be made for individuals to decontaminate their hands at the inspection site prior to resuming normal duties (e.g., driving a vehicle away from the site, taking a break to smoke, eat or drink, using toilet facilities). This can be accomplished by washing the gloved hands with soap and water, either provided in the building or carried on the vehicle, or with a dilute solution of household disinfectant; gloves can also be decontaminated with spray disinfectant. Three tablespoons of household bleach in one gallon of water may be used in place of a commercial disinfectant. At the end of the inspection procedure, the outside of the respirator and goggles should be sprayed with a mild disinfectant, such as Lysol or a dilute solution of water and hypochlorite bleach. When using a chlorine solution, avoid spilling the mixture on clothing or other items that may be damaged. Thoroughly wash hands with soap and water after removing gloves.

CHAPTER 7

CLEANUP PROCEDURES FOR RODENT CONTAMINATED BUILDINGS

1. The building to be decontaminated should be declared off limits to unauthorized personnel. This can be done by placing placards and a tape barrier around the structure. All entrances should be closed except for one designated entry/exit point. A decontamination station should be located in the immediate vicinity of the exit door (within the taped boundary) for personnel exiting the cleanup area. Windows should be opened to allow dissipation of contaminants that may have aerosolized inside the building. More information on decontamination of personnel following cleanup can be found in Chapter 9.

2. Areas with evidence of rodent infestations (e.g., rodent droppings, chewed materials) should be thoroughly treated with a wet disinfectant and cleaned to reduce the possibility of exposure to hantavirus-infected materials. Cleaning procedures must be performed in a manner that limits the potential for aerosolization of rodent-contaminated dust and other materials. Follow these procedures when cleaning up rodent infestations.

a. A site supervisor should be designated. This individual will act as team leader to ensure that all cleanup personnel are adequately briefed on the risks of acquiring hantavirus and the proper wearing of personal protective clothing and equipment. The site supervisor will provide a safety briefing to all individuals involved in the cleanup. See Appendices C and D for a Health and Safety Plan and a Hantavirus Safety Briefing.

b. All personnel involved in cleaning should wear protective equipment and clothing -- individually fit-tested respirators (with high-efficiency particulate air (HEPA) filters) or powered air purifying respirators (PAPR), goggles, solvent-resistant gloves, coveralls, and boots. More information on personal protection and personal decontamination procedures can be found in Chapter 9.

c. Spray the floors and those portions of the walls where evidence of rodent activity is present with a general-purpose disinfectant solution. Special attention must be given to dead rodents, rodent nests, droppings, food, or other items that have been contaminated by rodents; thoroughly soak these items with the disinfectant and place them in a double plastic bag. Use a shovel to remove the soaked material. Seal the plastic bags(s) when full or when the cleanup is completed and dispose of them in accordance with the installation s medical practices. More information on disposal of waste can be found in Appendix E. **Do not attempt to remove dry contaminated materials with a vacuum or by sweeping.**

NOTE: an exception to vacuuming can be made if the vacuum is equipped with a HEPA filter to capture minute particles of dust and other materials.

d. Mop all floors with water containing a general-purpose disinfectant and detergent. Clean carpets and upholstered furniture by steam cleaning or shampooing with commercial-grade equipment. Carpets can be effectively disinfected with household disinfectant, but care should be taken not to damage them with hypochlorite solutions. If rodents have nested inside furniture and the nests are not accessible for decontamination, the furniture should be sprayed with a disinfectant, then removed and burned. Spray all buildings with dirt floors with a general-purpose disinfectant before use. Remove rodent nests from furniture or equipment and decontaminate. Materials that cannot be decontaminated should be disposed of by burning or burying in accordance with the installation s medical practices.

e. Disinfect all work surfaces, storage cabinets, drawers, etc., by washing them with a solution of water containing a general-purpose disinfectant and a detergent followed by an additional wiping-down with disinfectant.

f. Launder any potentially contaminated clothing and bedding in hot water with a detergent. Use rubber or plastic gloves when handling the dirty laundry, then wash and disinfect the gloves in the decontamination solution. Items that cannot be laundered may be dry cleaned. NOTE: clothing and bedding should first be treated with a disinfectant to prevent contamination of individuals involved in laundering or dry cleaning.

CHAPTER 8

PERSONAL PROTECTION FOR WORKERS INVOLVED WITH SURVEILLANCE FOR RODENT-BORNE DISEASES

1. Rodents are found worldwide and there are very few geographic areas where there are no diseases associated with local rodent populations. Regardless of the setting and situation, it is always important to know what diseases may be present and to what extent they threaten the health of US forces and civilian personnel.

2. At the installation level, medical and veterinary personnel are usually involved with surveillance for diseases that affect the health of the command. Rodent-borne diseases fall into this category. Medical personnel are often found in the preventive medicine section of the local hospital or health clinic. At times, field preventive medicine units may augment the installation's medical surveillance mission. Pest control personnel may also be involved in surveillance for rodents but are usually not responsible for evaluating the medical threat associated with these animals. Additional medical personnel may also perform rodent-borne disease surveillance on military installations, although not directly stationed there. These individuals are usually associated with specialized preventive medicine support above the installation level and are called in to supplement the local medical staff when needed. The Air Force and Navy also teach operational entomology courses that may place students and instructors in intimate contact with rodents that harbor diseases. Because all of the individuals mentioned above can anticipate more than casual contact with rodents, they must be adequately protected from rodent-borne diseases.

3. Medical personnel who trap and handle rodents as part of their disease surveillance mission are among those at highest risk of contracting rodent-borne diseases. The tasks associated with trapping and handling rodents and their tissues may expose workers to parasites (both internal and external), aerosolized urine, saliva and excreta, rodent bites, and internal body fluids (i.e., blood). Methods for trapping and processing rodents can be found in USACHPPM Technical Guide 103, Plague Prevention and Control, and in the CDC's Methods for Trapping & Sampling Small Mammals for Virologic Testing (Reference 6).

4. Chapter 9 discusses detailed precautions and personal protection for individuals working with rodents where hantavirus may be present. The procedures and equipment used to reduce the risk of acquiring hantavirus infection offer protection from nearly all rodent-borne diseases. In addition, protection from arthropods that are vectors of rodent-borne diseases may be necessary because the protective suits used for hantavirus may not prevent insects from biting through the thin layers of clothing or deter from ticks crawling under clothing openings. AFPMB TIM No. 36, Personal Protective Techniques Against Insects and Other Arthropods of Military Significance (Reference 4), discusses protection from biting arthropods.

5. Adequate protective clothing should be worn when collecting traps that contain rodents. Since most rodent surveys rely on trapping rodents alive, the movement of the animal in the trap may result in contamination from urine and feces. If a closed trap is opened during the collection process, adequate precautions must be taken against breathing any aerosols created while opening and handling the trap and the rodent. When picking up traps, it is a good idea to use two sets of doubled plastic garbage bags (approximately 30-gallon size), one set made of light-colored material and the other set made of dark-colored material. Traps that are open and appear to have no rodent activity are placed in a double set of light-colored or clear bags. Those traps that are closed are assumed to contain rodents (even though some may be empty) and are placed in a double set of dark-colored bags. This practice both segregates rodents and traps that may be contaminated and saves time and cleaning efforts -- traps that have not had any rodent activity can be immediately used again or stored for future use.

a. Those personnel picking up traps should wear heavy solvent-resistant gloves (i.e., nitrile). The gloves can be sprayed with disinfectant in the field following trap pickup or bagged and washed with disinfectant at the processing site. If closed traps (suspected of containing rodents) are placed, without opening, directly into the bags, then the collector does not need to wear a respirator. However, the traps should always be kept downwind and away from the collector's breathing zone.

b. If traps are to be opened during collection, then the following protective equipment should be worn.

(1) Heavy solvent-resistant gloves (i.e., nitrile). The gloves can be disinfected as mentioned above.

(2) A half- or full-face mask fitted with high efficiency particulate air (HEPA) cartridges, or goggles (if a full-face respirator is not worn).

(3) A powered air purifying respirator (PAPR) can be worn, but this device usually limits visibility and tends to become uncomfortable when picking up traps, especially in wooded areas.

(4) Soldiers assigned to field preventive medicine units may wear their M-40 gas mask since this device protects against inhalation of virus particles. Although these masks offer good protection, they are unusually hot during summer months and also restrict vision.

NOTE: These procedures are used when trapping and handling field rodents only. When surveillance is being conducted in a cantonment area for house mice and rats, this level of protective equipment is not necessary since commensal rodents are usually not involved with hantaviruses that cause human disease in the Americas (exception - Seoul virus may be found in some port cities). However, if surveillance personnel are not sure what species of rodents they are working with, then protective equipment should be worn until the presence of field rodents is ruled out. Whenever rodents are handled, either during field investigations or when removing

dead rodents from traps in the cantonment area, appropriate protective measures must be taken. See Chapters 5 and 6 for more information about protection when working with commensal rodents. These procedures are also recommended for nonmedical personnel, such as mammalogists or wildlife biologists, who may handle live field rodents.

7. Since visual observation of rodents for diseases, particularly hantaviruses, may not indicate if the animals are infected, blood and/or tissue samples are usually taken from the trapped rodents for further analysis. This will most likely be done by medical personnel involved with trapping the rodents, as stated above. The following precautions should be taken to prevent individuals handling live rodents from acquiring disease.

a. All individuals involved in rodent processing and trap collection must be respirator fit-tested and aware of Centers for Disease Control and Prevention guidelines involved in rodent trapping and processing for hantavirus (Reference 6). If not fit-tested, individuals must be provided other appropriate protective equipment (e.g., PAPR or supplied air). Documentation of fit test may be required. If personnel do not have documentation, survey participation will be limited to trapping only.

b. The following procedures should be implemented:

(1) A baseline serum sample, preferably drawn at the time of employment, should be available from all persons whose occupations involve frequent rodent contact. The serum sample should be stored at -20^{o}C.

(2) Workers in potentially high-risk settings should be informed about the symptoms of hantavirus and be given detailed guidance on preventive measures. Information should include how to recognize rodent infestations or contamination.

(3) Workers who develop a febrile or respiratory illness within 45 days of the last exposure to rodent-infested or contaminated areas should seek medical attention immediately and inform the attending physician of the potential occupational risk of hantavirus infection.

c. The following personal protective clothing and equipment (Figures 8-1 and 8-2) are required when processing rodents for hantavirus detection:

(1) Surgical scrubs or other suitable garments that can be removed and laundered prior to leaving the processing site.

(2) Surgical gown with long sleeves and cuffs, or Tyvec suit.

(3) Plastic surgical apron (worn over the surgical gown or Tyvec suit).

(4) Surgical shoe covers.

(5) Two pairs of surgical gloves -- one pair fitted under the cuffs of the surgical gown and the second (outer) pair fitted over the surgical gown cuffs. When the Tyvec suit is worn, the sleeves are taped to the first pair of gloves; the second pair of gloves is fitted over the taped first pair.

(6) PAPR with hood. The inside hood flap is placed under the surgical gown or Tyvec suit, while the outer hood flap is placed on the outside of the gown or suit.

(7) Heavy gloves (to be worn over the surgical gloves) for handling rodent traps and for performing heart puncture blood collection (if this procedure is done).

NOTE: Soldiers in field medical units can get the same level of protection mentioned above by wearing MOPP Level 4 (Figure 8-3). When handling rodents, two sets of surgical gloves, usually available from field hospitals or aid stations, can be substituted if greater dexterity is required.

d. The perimeter of the rodent processing area will be marked by tape. Personnel will be suited up outside the perimeter and will enter to process the rodents. Once the processing has begun, those individuals who wish to leave must undergo thorough decontamination procedures (see Chapter 9).

Figure 8-1. Personal protective clothing and equipment.

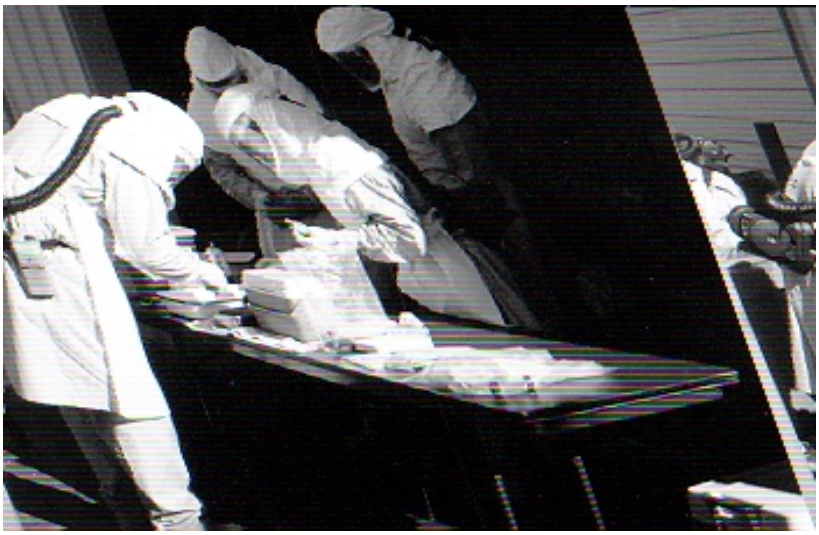

Figure 8-2. Heavy gloves are worn when performing heart puncture blood collection.

Figure 8-3. Soldiers wearing MOPP suits while processing rodents.

CHAPTER 9

PERSONAL PROTECTION AND DECONTAMINATION OF WORKERS INVOLVED IN PROCESSING RODENTS FOR DISEASES AND CLEANING RODENT-INFESTED BUILDINGS

1. INTRODUCTION.

a. Proper protective equipment must be worn by personnel processing rodents for hantavirus or cleaning up rodent-contaminated buildings. The objective of the decontamination procedures in this chapter is to minimize the risk of exposure to this deadly virus after the processing or cleanup is completed and the individual has taken off the protective clothing. The procedures for decontaminating personnel upon leaving the contaminated area are also addressed.

b. It will probably be necessary to have several individuals within the decontamination area to facilitate the process. This should not be a problem since processing rodents or cleanup of rodent-contaminated buildings usually takes several people.

c. Site conditions may require the use of drinking stations, and heat-related injuries should always be anticipated.

NOTE: Individuals should be fully hydrated before entering rodent processing or cleanup areas. Once the individual is exposed to potential hantavirus contamination, then decontamination must be performed before food or water is consumed.

d. Contaminated wash and rinse solutions and contaminated articles must be disposed of in the proper containers and in compliance with all regulations. See Appendix E for further information.

e. A baseline serum sample, preferably drawn at the time of employment, should be available from all persons whose occupations involve frequent rodent contact. The serum sample should be stored at -20^{o}C.

f. Workers in potentially high-risk settings should be informed about the symptoms of hantavirus and be given detailed guidance on preventive measures. Information should include how to recognize rodent infestations or contamination.

g. Workers who develop a febrile or respiratory illness within 45 days of the last exposure to rodent-infested or contaminated areas should seek medical attention immediately and inform the attending physician of the potential occupational risk of hantavirus infection.

h. Individuals involved in processing rodents or cleaning up contaminated buildings should wear the following personal protective clothing and equipment:

(1) Surgical scrubs or other suitable garments that can be removed and laundered prior to leaving the processing site.

(2) Surgical gown with long sleeves and cuffs, or Tyvec suit.

(3) Plastic surgical apron (worn over the surgical gown or Tyvec suit).

(4) Surgical shoe covers.

(5) Two pairs of surgical gloves -- one pair fitted under the cuffs of the surgical gown and the second (outer) pair fitted over the surgical gown cuffs. When the Tyvec suit is worn, the sleeves are taped to the first pair of gloves; the second pair of gloves is fitted over the taped first pair.

(6) PAPR with hood. The inside hood flap is placed under the surgical gown or Tyvec suit, while the outer hood flap is placed on the outside of the gown or suit.

(7) Heavy gloves (to be worn over the surgical gloves) for handling rodent traps and for performing heart puncture blood collection (if this procedure is done).

i. Safety procedures outlined in Appendices C and D should be followed at all times.

2. SITE SET-UP. Four work zones will be established at the processing site:

Hot (Exclusion) Zone
Observation Zone (see Hantavirus work site set-up map)
Warm Zone
Cold Zone

For details of the decontamination site, see Figure 9-1. Movement of personnel and equipment through these zones should be minimized and restricted to specific access control points (Decon corridor).

Hot Zone: A clearly marked outer boundary should delineate this area. The access control point should be located upwind of the contaminated area. This Zone contains Station One, the beginning of the Decon corridor. Personnel working in this area should have a full-faced respirator or PAPR, surgical scrubs over shorts and a T-shirt, a surgical gown or Tyvec suit with long sleeves that fit tightly around the wrists (tape if necessary), a plastic apron, two pairs of

surgical gloves (inner gloves may be taped to outer garment sleeves at wrists), and boot covers. The Hot Zone for buildings undergoing decontamination will be the entire structure with an extension leading away from the entrance.

NOTE: Access to a contaminated building should be limited. Only one entrance/exit should be utilized to prevent unauthorized personnel from entering and to ensure that those involved with the cleanup operation exit through the Decon corridor.

Observation Zone: This area is located just outside the Hot Zone. A half-face respirator may be worn in this area instead of a PAPR or full-faced respirator. No plastic apron, boots, or outer gloves are needed in this area. Personnel in this area are not allowed to participate in the handling of rodents or contaminated equipment. The recorder may assist in the Decon procedures but may not enter the Hot Zone. Station Two is located in the Decon corridor just over the Hot Zone boundary of Station One.

Warm Zone: A buffer zone between the Hot and Cold Zones where some survey support equipment is located (Decon equipment, emergency response equipment, additional processing equipment, personal protective equipment such as batteries for the PAPRs). The Decon corridor passes through the Warm Zone and the Third Station is located here.

Cold Zone: Personnel may wear regular work clothes within this zone. All administrative and support functions take place in this zone. The site supervisor should be located in the Cold Zone.

3. DECONTAMINATION.

a. One individual is designated the Decon Helper and makes sure all solutions are ready and all disposal containers are placed at the appropriate locations. Information on disposal of waste can be found in Appendix E.

b. The site supervisor must declare that all rodents for the day have been processed and that all samples are properly stored and the rodent data are correct and complete prior to starting the decontamination procedures. In the case of contaminated building cleanup, the site supervisor will declare that all decontamination procedures have been completed and will verify (by count) that all individuals have cleared the building.

(1) Proceed to Station 1 where the individual is misted completely but lightly by the helper with a dilute disinfectant solution over the entire outer covering of the body, concentrating on the boot area (Figure 9-2). Disinfectant application can best be accomplished using a 1- or 2-gallon compressed sprayer.

(2) Remove the boot covers and plastic apron and dispose of them in the refuse bag provided.

(3) Wash the outer gloves in dilute disinfectant solution in the bucket; remove the outer gloves and throw them into the medical waste bag at Station One.

(4) Step across the Hot Zone boundary line to Station 2.

(5) Helper will mist entire outer surface of protective clothing, including the PAPR.

(6) Unbuckle the PAPR battery pack unit and hand to helper (Figure 9-3).

(7) Step to Station 3. Remove PAPR hood (Figure 9-4) or respirator and lay it out in the sun. The helper will turn off the unit, plug the HEPA filters, and spray the PAPR unit and hood, being careful not to allow mist to enter the battery connections.

(8) Wash the inner gloves in the decontamination solution. Remove the second pair of gloves and throw them into the refuse bag.

(9) If a worker is wearing a full-face or half-face respirator, place the HEPA filters in the decontamination solution for 15 min., then throw them into a refuse bag. Wipe down the outside of the respirator with disinfectant.

(10) The helper will cap the HEPA filters used with the PAPR, mist the PAPR unit with decontamination solution, and remove the HEPA filters, placing them in a plastic bag, labeled with the processor s name, to be reused.

(11) Remove the surgical scrubs and have the helper spray them down before placing them in the scrub bag. The scrubs should be laundered as soon as possible. The Tyvec suit should be sprayed with disinfectant and then discarded in a refuse bag.

(12) Step to Station 4.

(13) Wash hands and face with mild soap provided; rinse well.

d. Repeat for all processors. As the decontamination procedures progress, the remaining personnel will Decon the last traps and make sure all data forms and equipment are secured for decontamination. All equipment will be decontaminated by spraying or wiping down with dilute disinfectant or appropriate biocide. The biohazard bag must be sealed before removal from the site.

e. The Hot Zone area will not be considered safe until the site supervisor declares it so. The site should be exposed to 30 minutes of direct sunlight, if possible, following decontamination procedures. This may be accomplished by removing any tarp or other overhead cover, if possible. If a permanent cover is in place, or the site is shaded by trees, then the site should be left intact for 30 minutes after the last individual has left the site.

Figure 9-2. Individual is completely misted with disinfectant.

Figure 9-3. Unbuckle the PAPR battery pack and hand to the helper.

Figure 9-4. Remove the PAPR hood.

APPENDIX A

REFERENCES

1. FM 8-33, Control of Communicable Diseases Manual, 16th edition, Abram S. Benenson, Editor, American Public Health Association, 1995.

2. U.S. Army Center for Health Promotion and Preventive Medicine Technical Guide No. 103, Prevention and Control of Plague, September 1995.

3. U.S. Army Center for Health Promotion and Preventive Medicine Technical Guide No. 138, Guide to Commensal Rodent Control, December 1991.

4. Armed Forces Pest Management Board (AFPMB) Technical Information Memorandum (TIM) No. 36, Personal Protective Techniques Against Insects and Other Arthropods of Military Significance, August 1996.

5. Centers for Disease Control and Prevention (CDC), Morbidity and Mortality Weekly Report, Hantavirus Infection - Southwestern United States: Interim Recommendations for Risk Reduction. Vol. 42, No. RR-11, 30 July 1993.

6. AFPMB Tim No. 40, Methods for Trapping & Sampling Small Mammals for Virologic Testing, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, September 1995.

7. A Commander's Guide to Infectious Waste Management at Army Health Care Facilities, U.S. Army Environmental Hygiene Agency, February 1990.

APPENDIX B

RESPIRATORS AND HEPA FILTERS AVAILABLE THROUGH THE PAPERLESS ORDER PLACEMENT SYSTEM (POPS)

Disposal Respirators

NSN No. 4240-01-272-1876 (size Medium)
4240-01-272-1877 (size Large)
Model - 3M* 9970 High Efficiency Respirator
High Efficiency Pre-Filter for 3M 5000 and 6000 Series Respirators

NSN No. 4240-01-320-1954
Model - 2040 HEP prefilter (may require purchase with the following Prefilter Adapter)

NSN No. 4240-01-320-1956
Model - 502 Prefilter Adapter
High Efficiency Filters for MSA+ Comfo II, Ultra Twin, and Belt Mounted Respirators
(NOTE: Combination HEPA and specific contaminant cartridges are also available. Consult manufacturer for specific NSN numbers)

NSN No. 4240-01-230-6894
Model MSA Type HEPA filter cartridge

Reusable Respirators

(NOTE: Combination HEPA and specific contaminant cartridges are also available. Consult manufacturer for specific NSN numbers)

NSN No. 4240-01-342-5237 (size Small)
Model - 6140 3M HEPA Respirator (6000 Series)

NSN No. 4240-01-342-5238 (size Medium)
Model - 6240 3M HEPA Respirator (6000 Series)

NSN No. 4240-01-342-2855 (size Large)
Model - 6340 3M HEPA Respirator (6000 Series)

High Efficiency Pre-Filters for 3M 7000 Series Respirators

NSN No. 4240-01-320-1954
Model - 2040 HEPA Prefilter (may require purchase with one of following Prefilter holders)

High Efficiency Pre-Filters for 3M 7000 Series Respirators (continued)

NSN No. 4240-01-320-1958
Model - 9286 Half Mask Holder

NSN No. 4240-01-320-1955
Model - 9891 Full Facepiece Holder

NSN No. 4240-01-246-5411
Model - 7255 High Efficiency Filter (may require purchase with the following retainer)

NSN No. 4240-01-231-7718
Model - 7288 High Efficiency Filter Retainer

Powered Air Purifying Respirator (PAPR)

NSN No. 4240-01-301-4364
Model - 3M PES6 Whitecap PAPR 7800S (L)

Filters for PAPRs

NSN No. 4240-01-301-4379
Model 3M High Efficiency Filter for 3M Whitecap W-3200 PAPR

NSN No. 4240-01-310-8874
Model - Racal P3 High Efficiency Filter for Breath Easy PAPR

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*3M is a registered trademark of the Minnesota Mining and Manufacturing Company, Inc., St. Paul, Minnesota

+MSA is a registered trademark of Mine Safety Appliance Company, Pittsburgh, Pennsylvania.

NOTE: Readers are advised to consult personnel knowledgeable in respirator selection and use. Respirators already in use may require only a HEPA prefilter, but proper selection is necessary to ensure component compatibility. Complete respirator assemblies with HEPA prefilters and associated canisters/cartridges also require proper selection. In either case, proper selection of HEPA prefilters, canisters or cartridges and complete assemblies must be made to ensure worker protection and adherence to respirator certification and approval. Not all POPS participants (manufacturers) and products are listed due to the variety of use situations and the number of manufacturers and products available. Interested parties are advised to contact manufacturers for assistance prior to ordering.

APPENDIX C

HEALTH AND SAFETY PLAN
FOR
HANTAVIRUS SURVEYS AND RODENT CLEANUP OPERATIONS

A. Site Information (fill in as appropriate).

Site:
Dates of Survey:
Weather Conditions:

Additional Information:

B. On-Site Organization and Coordination (fill in as appropriate).

Project Team Leader/Site Supervisor:

Scientific Advisor:

Site Safety Officer*:

Public Information Officer*:

Security Officer*:

Recordkeeper:

Field Team Leader:

All personnel arriving on the site should log in and out with the recordkeeper or site supervisor. Installation personnel(*) should be notified well in advance of the survey. Coordination of all facets of the survey should be done prior to rodent processing or cleanup operations.

HEALTH AND SAFETY PLAN CHECKLIST
FOR
HANTAVIRUS SURVEYS AND RODENT CLEANUP OPERATIONS

Done?	Activity
	Field plan for survey
	Hazard recognition
	Documentation
	Reporting procedure
	Safety officer
	Phone numbers
	Training--safety equipment, respirator fit test
	Follow-ups
	Personal protective measures
	Safety guidelines
	CDC - USACHPPM
	Water discipline
	Heat stress
	Site generated wastes
	Worst case scenario
	Personal protective equipment compromised
	Needle stick
	Injuries
	Blood to blood contact

SURVEY/CLEANUP TEAM MEMBERS

Name	Title	Address	DSN/Commercial:

C. On-Site Control.

_____ has been designated as site supervisor to coordinate access control and security on-site. A safe perimeter will be established around the processing/cleanup site. This area will be considered a contaminated area just prior to rodent processing/cleanup and all personnel will wear appropriate personal protective gear. After daily rodent processing, decontamination of area will be completed using an appropriate biocide. The area will be considered decontaminated after spraying down of site and equipment and 30 minutes of sunlight.

Description of processing/cleanup site with exact location and map:

D. Personal Protective Equipment.

All members involved in rodent processing, trap collection, and cleanup operations will be respirator fit-tested and aware of Centers for Disease Control and Prevention guidelines involved in rodent trapping and processing, and protection from hantavirus. If not fit-tested, these team members must be provided other appropriate protective equipment. Documentation of fit test may be required. If personnel do not have documentation, survey participation will be limited to trapping only.

Specific protective equipment needed includes:

Full- or half-face respirators with HEPA filters or PAPR
Splash goggles
Latex gloves
Tyvec coveralls or surgical gowns and surgical scrubs
Boots and boot covers
Leather or heavy rubber gloves for trap handling and needles
Plastic apron
_____
_____
_____

E. Trapping Rodents.

1. When collecting traps, the proper protective equipment should be worn. This includes gloves to prevent being cut by the traps, and a respirator when checking the traps for rodents. The surveyor s tape marking all positive traps will be labeled with the corresponding trap number to enable the return of all released rodents to the area where they were captured. All negative traps should be collected and put in a separate bag. Remove the surveyor s tape marking the negative traps at this time. Positive traps will be transported to a previously designated processing area in double black plastic bags (to minimize possible transmission of hantavirus to the collectors). This is to be done in a timely fashion to prevent animal mortality.

2. Once the traps have been transported to the processing area, they can be removed from the bags. The area is then considered "hot" and all personnel entering the processing area must wear the proper personal protective equipment. When all trap lines have been checked and all positive traps properly transported, rodent processing can proceed.

F. Processing Rodents.

Procedures will be completed at the designated processing site in the proper personal protective equipment. See Chapter 8 for a list of proper clothing and equipment.

G. Decontamination.

1. After processing/cleanup is finished, the entire processing bench and all equipment will be decontaminated with the appropriate solutions of disinfectant or biocide. All processing/cleanup equipment will either be soaked in solution or sprayed down and let set in the sun for at least 30 minutes. Comply with all label directions and any recommendations for use and disposal of decontamination solutions. See Chapter 9 for a detailed discussion of decontamination procedures.

2. Personnel will take off their personal protective equipment in the recommended sequence.

top gloves
plastic apron
respirator/PAPR
surgical gown
eye protection
boot covers
second layer of gloves
surgical scrubs or other outer clothing

3. When removing protective gear, a helper should assist by wiping off the respirator with a decontamination solution, then removing the HEPA filters.

4. The respirator should be further wiped down and stored in a plastic bag for use the next day.

5. The HEPA filters should be soaked in decontamination solution, double bagged and properly discarded.

6. All gloves, gowns, and boot covers will be disposed of after each use.

7. If a person needs to leave the "hot" area for any reason, the above procedure will be followed.

APPENDIX D

HANTAVIRUS SAFETY BRIEFING

1. Hazard Recognition. Because hantavirus is a deadly disease, all precautions outlined in this document will be followed.

a. The virus is transmitted by aerosolized particulates.

b. The modes of transmission are through cuts in the skin, eyes, mucus membranes, and inhalation.

c. All injuries, no matter how small, will be reported to the site supervisor, who will fill out an injury report.

d. Does anyone have facial cuts, blemishes, or hand cuts? Additional protection may be needed.

2. Personal Protective Equipment.

a. All survey and cleanup personnel should have proper training and clearance before they can wear a respirator. Has everyone been fit-tested and had a pulmonary function test? Does everyone have medical clearance to wear a respirator or a PAPR?

b. Personal Protective Equipment includes:

(1) Full-faced respirator or PAPRs, each equipped with HEPA filters. (HOT ZONE, all processors!).

(2) Splash goggles and half-face respirator (WARM OR OBSERVATION ZONE ONLY), recorder and observers.

(3) Two pairs of latex gloves (ALL ZONES).

(4) Puncture-resistant gloves for cardiac sticks and injecting rodents with anesthetic.

(5) Tyvec coveralls or surgical gowns, surgical scrubs, plastic aprons (ALL ZONES).

(6) Boots and boot covers (HOT ZONE ONLY).

(7) Leather or heavy rubber gloves for handling traps or sharp objects.

3. Heat Stress. The possibility of heat injury exists.

a. Use the buddy system and pay attention to fellow workers. Ask How do you feel? If anyone looks flushed or appears abnormally sweaty, take necessary precautions.

b. Try to limit time of rodent processing or cleanup operations to no more than three hours.

c. All personnel should be well hydrated.

d. Avoid drinking coffee, alcohol, or other dehydrants or diuretics while working.

e. If at any time anyone feels lightheaded, notify the site supervisor so decontamination procedures can be initiated at once.

f. If heat stress occurs during decontamination, hydration should begin ASAP.

4. Anesthetizing Rodents and Cardiac Puncture.

a. Puncture-resistant glove will be worn on the hand holding the rodent to prevent a needle stick.

b. Blood vials will be placed in a rack while rodent sera are injected from the syringe.

c. All needles will be disposed of in a sharps container.

5. Sharps Disposal.

a. Two sharps containers will be provided at the processing site:

(1) One at the Anesthetizing area.

(2) One at the Cardiac Puncture area.

b. The sharps containers will be secured each day after processing and not filled more than 3/4 full before discarding.

c. If at any time a syringe with needle is dropped, notify all processors to stop work, pick up the needle and place it into the sharps container prior to resuming rodent processing.

d. After the survey is completed, appropriate installation medical personnel (usually Preventive Medicine) will transport the containers to be properly disposed.

6. Decontamination.

a. There are three areas of decontamination:

(1) Traps.

(2) Processing/cleanup equipment.

(3) Personnel with protective clothing.

b. Traps.

(1) After removing rodents from traps, dump remaining grain, cotton balls and rodent excreta into a Red Bag (Regulated Medical Waste).

(2) Place traps in the first decontamination solution for 10 min.

(3) Wear heavy rubber gloves when removing traps from the first solution. Unfold traps and wash them with a brush in the second decontamination solution, removing all debris.

(4) Rinse the traps and lay them out in the sun in the observation zone.

(5) Once the traps are placed in the observation zone, they are not to be touched by a potentially contaminated worker.

c. Personal Protective Equipment.

(1) Proceed to Station 1 where the individual is misted completely but lightly by the helper with a dilute disinfectant solution over the entire outer covering of the body, concentrating on the boot area (Figure 9-2). Disinfectant application can best be accomplished using a 1- or 2-gallon compressed sprayer.

(2) Remove the boot covers and plastic apron and dispose of them in the refuse bag provided.

(3) Wash the outer gloves in dilute disinfectant solution in the bucket; remove the outer gloves and throw them into the medical waste bag at Station One.

(4) Step across the Hot Zone boundary line to Station 2.

(5) Helper will mist entire outer surface of protective clothing, including the PAPR.

(6) Unbuckle the PAPR battery pack unit and hand to helper (Figure 9-3).

(7) Step to Station 3. Remove PAPR hood (Figure 9-4) or respirator and lay it out in the sun. The helper will turn off the unit, plug the HEPA filters, and spray the PAPR unit and hood, being careful not to allow mist to enter the battery connections.

(8) Wash the inner gloves in the decontamination solution. Remove the second pair of gloves and throw them into the refuse bag.

(9) If a worker is wearing a full-face or half-face respirator, place the HEPA filters in the decontamination solution for 15 min., then throw them into a refuse bag. Wipe down the outside of the respirator with disinfectant.

(10) The helper will cap the HEPA filters used with the PAPR, mist the PAPR unit with decontamination solution, and remove the HEPA filters, placing them in a plastic bag, labeled with the processor s name, to be reused.

(11) Remove the surgical scrubs and have the helper spray them down before placing them in the scrub bag. The scrubs should be laundered as soon as possible. The Tyvec suit should be sprayed with disinfectant and then discarded in a refuse bag.

(12) Step to Station 4.

(13) Wash hands and face with mild soap provided; rinse well.

d. Processing Equipment.

(1) All equipment will be sprayed with the decontamination solution before declaring the area cold. This includes all tables, chairs, coolers, brooms, shovels, and other items.

(2) Expose all equipment to 30 min. of sunlight if possible.

We, the undersigned, have been briefed and have read this document, and we agree to comply with the aforementioned procedures.

Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature
Printed Name	Date	Signature

APPENDIX E

DISPOSAL OF WASTE GENERATED DURING HANTAVIRUS SURVEYS

1. Hazardous Waste: None generated.

2. Regulated Medical Waste (RMW):

a. The following will be treated as regulated medical waste:

Sharps. All sharps, including capillary tubes and other objects that could puncture skin, as well as opened but unused needles. Do not recap, bend, cut, or break sharps prior to disposal.

Gloves. Gloves used in handling potentially infected rodents.

Carcasses. Any potentially contaminated carcasses.

b. Handling/On-Site Storage.

Sharps are placed in impervious, rigid, and puncture-resistant lidded RMW containers. Once a sharp is in, it stays in.

All other RMW is placed in durable tear-resistant RMW bags (Red Bags - garbage bags are never acceptable).

3/4 full is as full as these containers get.

Once an object is placed in a RMW bag, it stays there. Do not rummage through the bag!

c. Transportation.

Transport in a closed government vehicle (not a rental car or POV) in a compartment separate from the passenger compartment.

d. Disposal.

Turn over to appropriate installation personnel (medical people typically). If medical personnel are not available on the installation, work with the installation to secure the material and find an approved disposal facility in the local area.

NOTE: Carcasses are stored in a refrigerated area with other pathological waste.

e. General. All other applicable federal, state and local regulations regarding waste generated on site should be followed. The USAEHA Commander's Guide to Infectious Waste Management at Army Health Care Facilities (Reference 7) is a useful resource.

3. Solid Waste.

a. Dilute Disinfectant Solution. Most diluted disinfectant solutions can be disposed of directly in the sanitary sewer, when convenient. When this is impractical, they can be released to the ground in small volumes. Keep in mind that many disinfectants will kill plants if enough is dumped in one place. Disinfectant labels and installation environmental personnel should provide adequate information on disposal methods.

b. All Other Personal Protective Equipment.

Materials should be double bagged using non-RMW bags (plastic garbage bags are suitable). HEPA filters should be immersed in disinfectant prior to placement in the bags.

The insides of the bags, along with their contents, are to be thoroughly sprayed with an appropriate disinfectant.

These bags will be carefully disposed of in a sanitary landfill.