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Rodent-Borne Diseases, with Special Emphasis on Protection from Hantavirus

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Foreword

This document provides guidance on the prevention of diseases caused by hantaviruses and the protection of individuals from rodent-borne diseases. Although these diseases are relatively uncommon, the high fatality rate from hantaviruses in the Americas, and the inability to determine infected from non-infected rodents by visual observation, heighten the need for awareness that must accompany rodent pest management and infestation mitigation. Personal protection measures against hantaviruses are presented for a variety of situations involving contact with rodents or rodent contamination. Use of the precautions in this manual should afford adequate protection to those involved.

Constructive comments are welcome and will be given full consideration in the updating of this document. Forward comments and recommended changes by e-mail to osd.pentagon.ousd-atl.mbx.afpmb@mail.mil, by fax to (301) 295-7473, or by mail to US Army Garrison Forest Glen, Armed Forces Pest Management Board, ATTN: Chief, Strategy & Information Division, 2460 Linden Lane, Bldg. 172, Silver Spring, MD 20910.

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Disclaimer

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Chapter 1. Rodent-Borne Diseases

1. Rodents are involved in the transmission of a variety of diseases 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 humans. 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., the 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. Hantaviruses are a good example of this scenario. There is no arthropod 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 rodent 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, a bacterial disease caused by *Streptobacillus moniliformis* or *Spirillum minus*.

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. Infectious Disease Risk Assessments (IDRAs) available through the National Center for Medical Intelligence (NCMI), Fort Detrick, MD – see https://www.ncmi.detrick.army.mil/.

b. Control of Communicable Diseases Manual, 20th ed., 2016. D. L. Heymann (ed.), American Public Health Association, Washington, DC. 729 pp. Available in book and digital subscription formats – see https://www.apha.org/ccdm.

c. Medical Entomology personnel located within the various services:

(1) The US Army Public Health Center (APHC), 8252 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5403, and its regional offices, toll-free 1-(800) 222-9698, Staff Duty Officer (410) 436-4375, DSN dialing from within CONUS 584-4375, from

OCONUS (312) 584-4375, secure fax (410) 436-7301, World Wide Web: (https://phc.amedd.army.mil/).

(2) The Navy and Marine Corps Public Health Center (NMCPHC), 620 John Paul Jones Circle, Suite 1100, Portsmouth, VA 23708-2103, (757) 953-0700, World Wide Web: https://www.med.navy.mil/sites/nmcphc/Pages/Home.aspx; and the Navy Entomology Center of Excellence (NECE), Building 937, Child Street, NAS Jacksonville, FL, (904) 542-4634 or DSN 942-4634, World Wide Web: https://www.med.navy.mil/sites/nmcphc/nece/Pages/default.aspx.

(3) The US Air Force School of Aerospace Medicine, Epidemiology Consult Service, Wright-Patterson AFB, OH 45433, 937-938-3078, DSN 798-3078, World Wide Web: https://www.wpafb.af.mil/afrl/711hpw/USAFSAM/.

d. The US Centers for Disease Control and Prevention (CDC), 800-232-4636, Visit CDC-INFO, Email CDC-INFO, World Wide Web: https://www.cdc.gov.

e. World Health Organization (WHO) information is accessible at reference libraries or from the WHO webpage at https://www.who.int/.

f. National, State, and local health officials for the location.

Table 1-1. Diseases, Other than Hantaviruses, Associated with Rodents.*

Disease	Rodent	Transmission	Region
American Trypanosomiasis	Numerous wild animals, including rats and mice	Contamination of abrasions, conjunctiva, skin wounds or mucous membranes (including bite site) following bite of infected vector Reduviidae (e.g., *Triatoma*, *Rhodnius*, and *Panstrongylus*	Western Hemisphere, especially Mexico, Central and South America
Babesiosis	Rodents serve as reservoirs for *B. microti* (and the related species *B. divergens* in Europe)	Bite of nymphal *Ixodes scapularis* ticks that have fed on infected rodents - *Dermacentor albipictus* in the West	United States - Northeast, Wisconsin (*B. microti*), California, Oregon, Washington (*B. duncani*), and Mexico (lesser-known but related *Babesia* spp. occur in Europe, Asia, and Africa)
Boutonneuse Fever	Same as RMSF	Bite of infected ticks; in the Mediterranean area by *Rhipicephalus sanguineus*, and in South Africa by *Haemaphysalis leachi*, *Amblyomma hebraeum*, *R. appendiculatus*, *Boophilus decoloratus*, and *Hyalomma aegyptium*	Africa, Europe, Middle Ease, and Southeast Asia

Disease	**Rodent**	**Transmission**	**Region**
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
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
Colorado Tick Fever	Ground squirrels, chipmunks, and *Peromyscus* spp.	Bite of infective tick, nymphal or adult *Dermacentor andersoni*	Mountainous regions above 5,000 feet in the western US and Canada
Cryptosporidiosis	Guinea pigs, mice, rats, and rabbits	Ingestion of infective sporulated oocysts	Worldwide
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 Europe, and *I. cookei* in eastern Canada and the US	Far eastern region of the former Soviet Union, Europe, Canada and the US
Giardiasis	Rodents, as well as other animals	Ingestion of cysts in contaminated water as well as fecal-oral contamination	Worldwide

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
Guanarito (Venezuelan) Hemorrhagic Fever	Cane rats (*Zygodontomys brevicauda*) and cotton rats (*Sigmodon alstoni*) are the reservoirs	Same as above	Venezuela
Hymenolepiasis	Mice and rats	Ingestion of eggs or infected intermediate hosts (insects) or by fecal-oral contamination	Africa, South America, the Caribbean, Italy, Japan, United States, the former Soviet Union
Junin (Argentinian) Hemorrhagic Fever	Wild rodents, primarily *Calomys musculinus*	Same as above	Argentina
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
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

Disease	Rodent	Transmission	Region
Leishmaniasis	Wild rodents serve as reservoirs	Bite of infective sand flies	The Middle East, former Soviet Union, Mediterranean littoral, Pakistan, India, China, sub-Saharan savanna, Sudan, Ethiopia, Kenya, Namibia, south-central Texas, Mexico, all of Central America, every South American country except Chile and Uruguay
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
Lyme Disease	Wild rodents, particularly *Peromyscus* spp.	Bite of infected ticks of *Ixodes* (subgenus *Ixodes*)	Eastern United States, Wisconsin and Minnesota, the West Coast, and Canada. Also found in Europe, the former Soviet Union, China and Japan
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
Machupo (Bolivian) Hemorrhagic Fever	The rodent *Calomys callosus* is the reservoir	Same as above	Bolivia

Disease	**Rodent**	**Transmission**	**Region**
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
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
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
Pasteurellosis	Mice may be infected, as well as rabbits	Infection in man is rare, but may be caused by the bite of infected rodents	Worldwide
Plague	Wild rodents, especially ground squirrels. Commensal rodents will also support outbreaks of plague in urban areas	Bite of infected fleas (other routes of transmission uncommon or rare, which includes aerosolization from infected felines in endemic areas)	Worldwide, maintained between outbreaks in sylvatic cycles of wild rodents and their fleas (primarily in semi-arid regions)
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

Disease	**Rodent**	**Transmission**	**Region**
Queensland Tick Fever	Same as RMSF above	Bite of infected ticks; *Ixodes holocyclus* is probably the principal vector	Queensland and New South Wales, Australia
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 tick-borne 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
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**
Rocky Mountain Spotted Fever	Maintained in nature in ticks by transovarial and transstadial passage - ticks often carried and supported by rodents	Bite of infected ticks; in the US by *Dermacentor variabilis, D. andersoni*, and *Amblyomma americanum*, *Rhipicephalus sanguineus* and in Latin America by *A. cajennense* (possibly also *Rhipicephalus sanguineus*)	United States, Canada, Mexico, Panama, Costa Rica, Colombia, and Brazil
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
Salmonellosis	Wild rodents	Ingestion of food contaminated by feces of infected animal	Worldwide
Schistosomiasis	Rodents are potential hosts of *Schistosoma japonicum*. *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
Scrub Typhus	Transovarial passage in mites - mites that are often supported by rodents	Bite of infected larvae of certain chigger mites (*Leptotrombidium* spp.)	East and Southeast Asia, North Australia

Disease	**Rodent**	**Transmission**	**Region**
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
Trichinellosis	Rats and many wild animals	Eating undercooked or raw meat containing encysted larvae	Worldwide
Tularemia	Wild rodents: voles, muskrats, beaver; also lagomorphs (rabbits, hares)	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

Chapter 2. Hantaviruses

1. Two types of human disease are caused by hantaviruses. One group of hantaviruses causes hemorrhagic fever with renal syndrome (HFRS), while another group causes hantavirus pulmonary syndrome (HPS). It is not known whether all hantaviruses cause human disease. Additional information about hantaviruses can be found in Table 2-1.

a. Hemorrhagic fever with renal syndrome (HFRS) is mostly associated with 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 5-15 percent) but can cause incapacitating severe illness for up to several weeks, with convalescence from weeks to months. The CDC provides these symptoms (CDC, 2020a):

> Initial symptoms of HFRS begin suddenly and include intense headaches, back and abdominal pain, fever, chills, nausea, and blurred vision. Individuals may have flushing of the face, inflammation or redness of the eyes, or a rash. Later symptoms can include low blood pressure, acute shock, vascular leakage, and acute kidney failure, which can cause severe fluid overload. The severity of the disease varies depending upon the virus causing the infection. Hantaan and Dobrava virus infections usually cause severe symptoms, while Seoul, Saaremaa, and Puumala virus infections are usually more moderate. Complete recovery can take weeks or months. Symptoms of HFRS usually develop within 1 to 2 weeks after exposure to infectious material, but in rare cases, they may take up to 8 weeks to develop.

The reservoirs of HFRS are usually field rodents, i.e., "wild" rodents, rather than commensal rodents, with the exception of Seoul virus, which is maintained by *Rattus* spp. Known carriers include the striped field mouse (*Apodemus agrarius*), the reservoir for both the Saaremaa and Hantaan virus; the brown or Norway rat (*Rattus norvegicus*), the reservoir for Seoul virus; the bank vole (*Clethrionomys glareolus*), the reservoir for Puumala virus; and the yellow-necked field mouse (*Apodemus flavicollis*), which carries Dobrava virus.

b. Hantavirus pulmonary syndrome (HPS) is an acute viral disease that primarily affects the lungs. The illness, which can cause respiratory failure and cardiogenic shock, has a fatality rate of approximately 35 percent. The CDC provides these symptoms (CDC, 2020b):

> Early symptoms of HPS include fatigue, fever and muscle aches, especially in the large muscle groups—thighs, hips, back, and sometimes shoulders. These symptoms are universal. There may also be headaches, dizziness, chills, and abdominal problems, such as nausea, vomiting, diarrhea, and abdominal pain. About half of all HPS patients experience these symptoms. Late Symptoms appear four to 10 days after the initial phase of illness. These include coughing and shortness of breath, with the sensation of, as one survivor put it, a "…tight band around my chest and a pillow over my face" as the lungs fill with fluid. HPS has a mortality rate of 38%. Due to the small number of HPS cases, the "incubation time" is not positively known. However, on the basis of limited information, it appears

that symptoms may develop between 1 and 8 weeks after exposure to fresh urine, droppings, or saliva of infected rodents.

Unlike HFRS, recovery from HPS is usually 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, or when opening or working with pieces of equipment that have been infested by rodents.

2. For recent virus taxonomy and nomenclature see Adams et al., 2017 and Laenen et al. 2019 in References Cited.

a. Before the 1993 outbreak of HPS in the US, 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 (SNV), well before SNV was propagated in cell cultures. The successes of RT-PCR in the rapid detection and genetic characterization of SNV, as well as the development of diagnostic antigens through recombinant DNA expression of SNV 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. However, for many hantaviruses, there are well-documented examples of a rodent other than that listed in Table 2-1 playing an important 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 SNV. 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. Hantaviruses have been detected in detected in or isolated from rodents, insectivores (in particular shrews and moles), bats, reptiles, and fish (Laenen et al. 2019).

3. As of January 2017, 728 cases of hantavirus disease have been reported since surveillance in the United States began in 1993, with 262 deaths for a fatality rate of 36% for identified cases (CDC, 2020c).

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 (e.g., fighting, grooming, exposure to saliva, 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 probably attributed to other causes, usually pneumonia since the lungs are involved. There does appear to be evidence 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 US have been caused by SNV. Following the initial discovery of SNV in 1993, other hantaviruses have been found in this country that cause disease in people.

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

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

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 (PHV), 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. *Peromyscus maniculatus*, the deer mouse, has been implicated as the primary reservoir for SNV.

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. Except for Andes virus in South America, person-to-person transmission of hantaviruses has not been documented. Cats and dogs are not known to be reservoirs of hantaviruses in the US, but these animals may bring infected rodents into contact with humans.

11. Traveling in areas where human hantavirus cases have been reported is generally 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, but is likely no more than several days. Ultraviolet light (sunlight) has been shown to inactivate hantaviruses, but sunlight will not disinfect large agglomerations of feces.

13. The high and often rapid fatality is ample reason for concern. Because we 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) and *Rattus rattus* (black rat)	Worldwide	Worldwide
Puumala (PUU)	HFRS	*Clethrionomys glareolus* (bank vole)	Europe, Russia, Scandinavia	Palearctic from Scandinavia to Lake Baikal, south to France and 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 (PHV)	nd	*Microtus pennsylvanicus* (meadow vole)	United States, Canada	C Alaska to Labrador, Newfoundland and Prince Edward Island, Canada; Rocky Mountains to N New Mexico, Great Plains to N Kansas, mid-Atlantic states, Appalachians to N Georgia, USA

Species	Disease	Principal Reservoir	Distribution of Virus	Distribution of Reservoir
Khabarovsk (KBR)	nd	*Microtus fortis* (reed vole)	Russia	Transbaikalia Amur region; E China
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 (SNV)	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 (NYV)	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 Reservoir**	**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
Muleshoe (MUL)[d]	nd	*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

Probable Species[e]	**Disease**	**Principal Reservoir**	**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: C. Schmaljohn and B. Hjelle. 1997. Hantaviruses: A Global Disease Problem. Emerg. Inf. Dis., vol. 3(2): April - June.

[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 rate of hantavirus-positive rodents from a given trapping location may not accurately represent the virus' prevalence in other areas. Geographic areas within the Southwest US have shown hantavirus infection prevalence in certain populations of *P. maniculatus* to be as high as 70 percent. However, the number of positive or negative rodents may vary significantly from location to location, seasonally, and from one 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 and poison bait. Glue boards not be used because infected animals trapped on them can continue shedding virus, and they are not a humane method. They should only be used if there is no alternative. Poison baiting should only be done indoors. See Sikes et al., 2011 for guidance on acceptable trapping techniques.

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 available to rodents should be eliminated.

3. Rodent surveillance should be conducted before occupying any seldom-used buildings. These buildings should first be aired out for at least 30 minutes prior to entering the building. Inspections of equipment and supplies stored in them 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 hantavirus case can be traced to direct contact with rodents or with rodent infestations in enclosed spaces. Rodent urine and feces pose the greatest health risk to people. Risk is increased when rodent droppings or urine are aerosolized in enclosed spaces such as buildings, bunkers or warehouses. Persons moving equipment, cleaning buildings, or otherwise disturbing deposited urine or feces may be at risk if not adequately protected. Exercises simulating combat conditions can put Service members at risk: a large cluster of hantavirus disease occurred among US soldiers exercising in January 1990 in southern Germany and camping in tents in a mice-infested area. Within 2 weeks, 24 acute Puumala virus infections were documented, and 14 soldiers had to be hospitalized with varying degrees of acute renal failure, whereas no outbreak occurred in the civilian population of the surrounding area (Clement et al., 1997). Although hantavirus pulmonary syndrome (HPS) is a rare illness in eastern Canada, three cases of HPS among military personnel sharing a common exposure to mouse excreta while engaged in military training in Alberta, Canada were diagnosed in Quebec in June and July of 2015 (Parkes et al., 2016).

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 may 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 may be due to:

a. Infected rodent excreta may be less concentrated outdoors.

b. Winds (air movement) may dissipate any aerosolized virus.

c. Direct exposure to sunlight for >30 min. may destroy any viable hantavirus.

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

People involved in outdoor activities such as rural- and forest-related activities, for example, farm workers in the field, can be at a higher risk (Marx et al., 2017; Watson et al., 2014). Among military specialties, in addition to those involved in outdoor military training, those who can be considered at a higher risk include pest controllers, wildlife biologists, 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 stored frozen (at -20oC) for future analysis if 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 CDC as a special report in the MMWR (see References Cited). When respirators are required, workers are required to be enrolled in a respiratory protection program in accordance with 29 CFR 1910.134. Appendix B lists the respirators and HEPA filters available through. 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 of 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
Warfighters, hikers, campers and other similar users	Outdoor activities	None	Chapter 4
Warfighters, hikers, campers and other recreational users for whom indoor activities are not mandatory	Indoor activities - initial entry into building or structure	Leave building immediately if rodents or rodent contamination found	Chapter 4
Warfighters, hikers, campers and other similar recreational users	Indoor activities - activities require presence in rodent-contaminated building	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter or PAPR	Chapters 6, 7, and 9
Family housing residents	Disposal of rodents and traps	Plastic gloves, plastic bags, and disinfectant	Chapter 5
Pest controllers	Disposal of rodents and traps (cantonment area)	Plastic gloves, plastic bags, and disinfectant	Chapter 5
Plumbers, electricians and similar technical 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 or PAPR if signs of rodents or rodent 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, respirator with HEPA filter or PAPR	Chapters 7 and 9
Medical personnel, pest controllers, range control or similar	Inspect buildings for rodents or rodent contamination	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter or PAPR	Chapters 6, 7, and 9
Medical personnel (including field medical), mammalogists, wildlife biologists, and similar	Collecting rodent traps	Gloves, coveralls, goggles, work boots or shoes, respirator with HEPA filter or PAPR; warfighters can wear the M-40 mask as a respirator	Chapters 8 and 9
Medical personnel (including field medical), mammalogists, wildlife biologists, and similar	Handling and processing rodents	Coveralls or surgical scrubs, surgical gown, plastic apron, two pairs of surgical gloves, boot covers, respirator with HEPA filter or PAPR; warfighters can wear MOPP Level 4 in lieu of above	Chapters 8 and 9

Chapter 4. Precautions for Personnel Camping, Hiking, or Engaging i 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 the CDC (Centers for Disease Control and Prevention, 2002), should be taken:

a. Avoid 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. Warfighters bivouacking in the field are at minimal risk if the procedures listed above are followed. However, if warfighters 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 indoors. 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. 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

Most rodents captured in cantonment buildings will be domestic rodents, not wild rodents ("field rodents"). However, in rural areas of California, almost all rodent captures indoors have been *Peromyscus* species deer mice, and above 4,000 feet elevation, indoor captures are almost exclusively deer mice (Novak, 2020), so it cannot always be assumed that rodents found indoors are not wild rodents. In some cases, wild rodents enter homes, and are trapped there. Where Norway rats or black rats are involved, including domesticated rats kept at pets, the possibility of Seoul virus infection must be considered. If field rodents or known rodent vectors are captured, or if signs indicate an ongoing rodent infestation of long-term duration, then rodent trapping and disposal should be performed by a knowledgeable professional with higher-level protective clothing and equipment. A family housing unit heavily infested with field rodents should be treated the same way as any other rodent-contaminated building (see Chapter 7).

1. Wildlife managers, law enforcement, pest management professionals, family housing occupants and other individuals on installations may on occasion have to dispose of dead rodents and decontaminate rodent traps. When captured rodents are NOT to be used for scientific investigation (e.g., hantavirus detection), the following procedures should be followed:

Note: Always keep rodents and traps away from the face, and downwind when working outdoors or when there is an air current indoors (e.g., fan, air conditioner).

a. Individuals handling rodents or traps should wear impermeable, washable gloves. If gloves are not available, a plastic bag inverted over the hand can be used to pick up a trap with a rodent in it or a rodent-contaminated trap. After grasping the trap with the bag-protected hand, the rest of the bag is then pulled over the trap. The inside of the bag, as well as the rodent and trap, should be sprayed with a disinfectant, complying with all label directions and any recommendations for use and disposal of decontamination solutions. The bag should then be sealed with its zip lock or a twist tie, rolled up in paper, such as newspaper, and placed in a trash receptacle.

b. Dispose of dead rodents by first spraying the rodent, trap and surrounding area, complying with all label directions and any recommendations for use and disposal of decontamination solutions. Pick up the trap with rubber or plastic gloves, and drop the carcasses in a plastic bag containing sufficient general-purpose disinfectant to thoroughly wet the carcasses. The disinfectant may be sprayed into the bag or liquid may be added. Seal the bag, double-bag it inside another bag, and then seal the outer bag and 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, however, bleach solutions have a shorter efficacious shelf-life than commercial disinfectants so commercial disinfectants should be used preferentially.

c. If the traps can be disposed of, leave the carcasses in the traps for disposal. If the trap must be re-used, they must be disinfected with a commercial disinfectant or bleach solution, complying with all label directions and any recommendations for use and disposal of the decontamination solutions. The trap may be sprayed in place, decontaminated in the bag with the rodent, or treated separately after the rodent is removed.

d. Thoroughly wash hands with soap and water.

2. When captured rodents are to be used for scientific investigation (e.g., hantavirus detection), disinfecting the rodent carcasses can interfere with subsequent analytical procedures. In this case, the 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, complying with all label directions and any recommendations for use and disposal of decontamination solutions. The inner surfaces of the container should not be sprayed with disinfectant—the rodents should not be exposed to anything that could alter the ability to extract viruses at a later date. After closing for transport, care should be taken to prevent unauthorized personnel from opening the container—it should only be opened inside a bio-hood and handled by personnel wearing appropriate protective equipment. When the container is emptied, the inside must be disinfected. 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 should be sprayed with disinfectant at the trap site before being removed from buildings, complying with all label directions and recommendations for use and disposal of decontamination solutions. Avoid using glue boards—not only are they inhumane, they also allow the rodent to continue shedding viruses. 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 HPS in the US, but Norway rats and black rats (also known as ship rats, roof rats, or house rats), *Rattus rattus*, 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—see Chapter 2, paragraphs 1a and 1b—and be given detailed guidance on preventive measures. Information should include how to recognize rodent infestations or contamination.

b. Symptoms typically develop between 1-5 weeks after exposure, but workers who develop a febrile or respiratory illness within 8 weeks of their last exposure to rodent-infested or contaminated areas should seek medical attention immediately and inform the attending physician of the potential 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) 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 done in the building cannot be postponed for inspection and decontamination, wear respirators fitted with HEPA filters.

(4) Adequate handwashing facilities should be provided at the site, especially if known or potentially rodent-contaminated dust and soil might be 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. Light contamination may mean several rodent droppings in a limited area, 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 to inspect 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 waiting 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 -20ºC.

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 8 weeks 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 or an N100 respirator. These devices protect against breathing aerosolized rodent urine or fecal particles containing virus and also provide protection of the mouth and nose from gloved hands that have handled rodent-contaminated materials.

(6) Respirators that rely on positive air pressure for protection (e.g., PAPR - Powered Air Purifying Respirator, see Figure 6) can be worn by individuals with or without facial hair. If the individual will be wearing a respirator for a prolonged period of time (e.g., more than one hour), a PAPR 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.

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.

f. Provision 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, provided in the building or carried on the vehicle, or with a household disinfectant, complying with all label directions and recommendations for use and disposal of decontamination solutions. Gloves can also be decontaminated with spray disinfectant. Household bleach, 3 tablespoons per gallon of water, may be used in place of a commercial disinfectant, however, bleach solutions have a shorter efficacious shelf-life than commercial disinfectants, so commercial disinfectants should be used preferentially. At the end of the inspection, the outside of the respirator and goggles should be cleaned, following the manufacturer specifications. If the manufacturer specifications allow it, a mild disinfectant, such as Lysol™ or a dilute solution of water and hypochlorite bleach, can be used, again, complying with all label directions and recommendations for use and disposal of decontamination solutions. When using chlorine solutions, avoid spillage on clothing or other items that bleach may damage. Thoroughly wash hands with soap and water after removing gloves.

Figure 6. A PAPR with a rigid, tight-fitting mask.

Chapter 7. Cleanup Procedures for Rodent Contaminated Buildings

1. Appendix F, Hantavirus Prevention: Cleanup of Rodent Contamination, provides additional guidance on safe removal of rodent contamination from buildings. Eleven scenario boxes describe "Personnel Involved", "Level of Rodent Contamination", "Protective Clothing and Equipment", and "Cleanup Methods." Two scenarios, "Vehicle Maintenance Personnel" and "Personnel Cleaning out Electrical Utility Boxes," do not involve buildings, but a clear health risk exists for personnel removing rodent contamination under the conditions described.

2. A 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 and doors should be opened for at least 30 minutes 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.

Note: Always check with local public health authorities for recommendations when cleaning heavy infestations, as local offices in the US and in other countries often have specific recommendations directly relevant to the work being done at a particular location.

Check CDC guidelines for Cleaning Up After Rodents, at https://www.cdc.gov/rodents/cleaning/index.html, for the most up-to-date guidance.

3. 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, complying with all label directions and recommendations for use and disposal of decontamination solutions. 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 must wear protective equipment and clothing. Light infestations that can be sprayed and cleaned up without otherwise disturbing the droppings should not pose an airborne hazard. However, cleanup of larger amounts of contaminants that will most likely be aerosolized during the cleanup operation requires respirator use, e.g., individually fit-tested respirators (with high-efficiency particulate air (HEPA) filters or National Institute for Occupational Safety and Health approved N100 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, complying with all label directions and recommendations for use and disposal of decontamination solutions. 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 installations 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: Vacuuming should not be used even if the vacuum is equipped with a HEPA filter.

d. Mop all floors with water containing a general-purpose disinfectant and detergent, complying with all label directions and recommendations for use and disposal of decontamination solutions. Clean carpets and upholstered furniture by steam cleaning or shampooing with commercial-grade equipment. Carpets can be effectively disinfected with household disinfectants, but care should be taken to avoid damaging them with hypochlorite (bleach) solutions. Remove rodent nests from furniture or equipment and decontaminate. 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. If possible, set them outside in the direct sunlight for several hours before handling. Materials that cannot be decontaminated should be set outside in the direct sunlight for several hours if possible, and then disposed of by burning or burying in accordance with the installation's 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, complying with all label directions and recommendations for use and disposal of decontamination solutions.

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, complying with all label directions and recommendations for use and disposal of decontamination solutions.

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 AFPMB TG 40, Methods for Trapping and Sampling Small Mammals for Virologic Testing.

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 stop ticks from crawling in through clothing’s openings. AFPMB TG 36, Personal Protective Techniques Against Insects and Other Arthropods of Military Importance, 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. 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, complying with all label directions and recommendations for use and disposal of decontamination solutions. If closed traps (suspected to contain rodents) are placed, without opening, directly into the bags, then the collector does not need to wear a respirator. However, traps should always be kept downwind and away from that person'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 (e.g., 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 an N100 respirator and 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) Warfighters 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: 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, does 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 CDC guidelines involved in rodent trapping and processing for hantavirus. 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°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 8 weeks 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 Tyvek suit.

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

(4) Surgical shoe covers or, preferably, rubber boots that can be disinfected with chemical foot baths as personnel exit the area. Shoe covers disintegrate when disinfected.

(5) Two pairs of surgical gloves—one pair fitted under the surgical gown cuffs and the second (outer) pair fitted over the surgical gown cuffs. When a Tyvek 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 Tyvek suit, while the outer hood flap is placed on the outside of the gown or suit.

(7) Heavy leather or chain mail gloves (to be worn over the surgical gloves) for handling rodent traps and when using needles or other sharps. Gloves may not be needed if animals are sedated or dead.

Note: Warfighters 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. The two-glove system is preferred if animals are sedated or dead. For MOPP suit laundering, follow guidance in Chapter 7.

d. The perimeter of the rodent processing area will be clearly 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 blood collection.

Figure 8-3. Warfighters wearing MOPP Level 4 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 their protective clothing. The procedures for decontaminating personnel upon leaving the contaminated area are also addressed.

b. The decontamination process will require the participation of several individuals. 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 work-rest cycles should be employed to mitigate heat-related injuries.

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 8 weeks 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 Tyvek suit.

(3) Plastic surgical apron (worn over the surgical gown or Tyvek suit). (4) Surgical shoe covers.

(5) Two pairs of surgical gloves -- one pair fitted under the surgical gown's cuffs and the second (outer) pair fitted over the surgical gown cuffs. When a Tyvek 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 Tyvek suit, while the outer hood flap is placed on the outside of the gown or suit. The PAPR is recommended over N100, full, or half-face respirators because the PAPR offers head protection from virus particles.

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

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

2. Site Set-Up. Establish four work zones at the processing site: Hot Zone, Observation Zone, Warm Zone, Cold Zone, as described following. Prepare a map for reference.

a. Movement of personnel and equipment through these zones should be minimized and restricted to specific access control points ("decon corridor").

b. 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 Tyvek 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, known as the decon corridor, 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.

c. 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 required 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.

d. 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.

e. 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. Prior to starting the decontamination procedures, 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 disinfectant solution, prepared according to label instructions, over the entire outer covering of the body, concentrating on the boot area. Disinfectant application can best be accomplished using a 1- or 2-gallon compressed sprayer. All label directions and recommendations for use and disposal of decontamination solutions must be followed.

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

(3) Wash the outer gloves in disinfectant solution in the bucket; remove the outer gloves and throw them into the medical waste bag at Station 1.

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

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

(6) Unbuckle the PAPR battery pack unit and hand to helper.

(7) Step to Station 3. Remove PAPR hood 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 or N100 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 filters used with the PAPR, mist the PAPR unit with decontamination solution, and remove the filters, placing them in a plastic bag, labeled with the processors 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 Tyvek suit should be sprayed with disinfectant and then discarded in a refuse bag, complying with all label directions and recommendations for use and disposal of decontamination solutions.

(12) Step to Station 4.

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

c. 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 disinfectant or appropriate biocide, complying with all label directions and recommendations for use and disposal of decontamination solutions. The biohazard bag must be sealed before removal from the site.

d. 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. 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.

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Appendix B. Respiratory Protection

1. Selection of appropriate respirators should be coordinated with local medical and safety personnel. Most military installations have a selection of respirators that protect workers against locally identified hazards, including pesticide application. All respirators should be fit-tested to the worker by competent medical personnel. All respirators must be approved by the National Institute for Occupational Safety and Health (NIOSH) and/or Mine Safety Health Administration (MSHA) approval.

Note: The Pest Management function should contact the appropriate medical office before purchasing any respiratory protective equipment. The following offices have primary responsibility for identifying respiratory equipment requirements at each military installation:

USA: Preventive Medicine Activity

USN/USMC: Occupational Health/Industrial Hygiene

USAF: Bioenvironmental Engineering

2. To maintain respiratory protection devices, wash all rubber surfaces with soap and water after each day's use. Follow the manufacturer's instructions on maintenance of the respirator. Store respirators in a cool dark area if storage is to be prolonged. Discard cartridges after 8 hours of actual use, sooner if breathing becomes difficult.

3. 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.

Appendix C. Health and Safety Plan for Hantavirus Surveys and Rodent Cleanup Operations

A. Site Information.

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*: _____

Record Keeper: _____

Field Team Leader: _____

All personnel arriving on the site should log in and out with the record keeper or site supervisor. Installation personnel (*) should be notified 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 - USAPHC
	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	Telephone No.

C. On-Site Control Designation

_____ 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, N100 respirator, or PAPR
- Splash goggles
- Latex gloves
- Tyvek coveralls or surgical gowns and surgical scrubs
- Disinfectable 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 must be worn. This includes gloves to prevent being cut by the traps, and a respirator when checking the traps for rodents. The surveyors tape marking all positive traps will be labeled with the corresponding trap number to match the rodents to the area where they were captured. All negative traps should be collected and put in a separate bag. Remove the surveyors 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 Chapters 7 and 8 for 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 infection can be deadly, all precautions outlined in this document will be followed.

a. The virus is transmitted in aerosolized particulates from infected wild rodent urine and feces.

b. The symptoms of HRRS and HPS include:

HFRS (CDC, 2020a):

> Initial symptoms of HFRS begin suddenly and include intense headaches, back and abdominal pain, fever, chills, nausea, and blurred vision. Individuals may have flushing of the face, inflammation or redness of the eyes, or a rash. Later symptoms can include low blood pressure, acute shock, vascular leakage, and acute kidney failure, which can cause severe fluid overload. The severity of the disease varies depending upon the virus causing the infection. Hantaan and Dobrava virus infections usually cause severe symptoms, while Seoul, Saaremaa, and Puumala virus infections are usually more moderate. Complete recovery can take weeks or months. Symptoms of HFRS usually develop within 1 to 2 weeks after exposure to infectious material, but in rare cases, they may take up to 8 weeks to develop.

HPS (CDC, 2020b):

> Early symptoms of HPS include fatigue, fever and muscle aches, especially in the large muscle groups—thighs, hips, back, and sometimes shoulders. These symptoms are universal. There may also be headaches, dizziness, chills, and abdominal problems, such as nausea, vomiting, diarrhea, and abdominal pain. About half of all HPS patients experience these symptoms. Late Symptoms appear four to 10 days after the initial phase of illness. These include coughing and shortness of breath, with the sensation of, as one survivor put it, a "…tight band around my chest and a pillow over my face" as the lungs fill with fluid. HPS has a mortality rate of 38%. Due to the small number of HPS cases, the "incubation time" is not positively known. However, on the basis of limited information, it appears that symptoms may develop between 1 and 8 weeks after exposure to fresh urine, droppings, or saliva of infected rodents.

c. Other potential rodent-borne diseases specific to the location and species involved include: (see Table 1-1 for information about potential diseases).

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

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

f. 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 leather or mail gloves for live-animal cardiac sticks and injecting rodents with anesthetic; for sedated or dead rodents, two sets of surgical gloves.

(5) Tyvek 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. Due to the safety gear required, the possibility of heat injury exists.

   a. Use work-rest cycles to mitigate heat stress.

   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, remove individual from HOT to WARM ZONE and initiate hydration.

4. Anesthetizing rodents and drawing blood.

   a. Per current animal care and use standards, cardiac punctures are only acceptable on rodents that will be euthanized. Alternatively, capillary tubes can be used to take blood samples from the retro-orbital sinus.

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

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

   d. 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 if that procedure is used.

   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 personnel) 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 with disinfectant 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. 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 1.

(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.

(7) Step to Station 3. Remove PAPR hood 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 to not 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 processors name, to be reused.

(11) Remove the surgical scrubs and have the helper spray them down with disinfectant before placing them in the scrub bag. The scrubs should be laundered between 15 minutes and ½ hour after being sprayed with disinfectant. The Tyvek 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 until saturated with the decontamination solution before declaring the area cold. This includes all tables, chairs, coolers, shovels, and other items. Items containing organic materials or with many crevices are almost impossible to disinfect using the spray method; it is better to soak these in a bucket or discard them as contaminated waste.

(2) Expose all surfaces of equipment being decontaminated to direct sunlight for 30 minutes, if possible.

Team Agreement

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 should 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 officials, usually). 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 can be 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.

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.

Bags containing thoroughly disinfected materials may be disposed of as regular garbage in sanitary landfills.

Appendix F. Cleanup of Rodent Contamination

Hantaviruses in the Americas may cause human disease involving the lungs, hence the name "hantavirus pulmonary syndrome" (HPS). The deer mouse, *Peromyscus maniculatus*, is the primary reservoir for Sin Nombre virus (SNV). This was also confirmed by USAPHC-West surveillance at 44 military installations, mostly in the western half of the United States, where 12% of the *P. maniculatus* sampled were positive for SNV. The deer mouse is found in most of North America and frequently enters buildings, including those on military installations. Hantaviruses that cause illness in humans are also found in other rodents, but the number of cases stemming from these hantaviruses is small when compared to SNV. Hantavirus is shed in rodent urine and feces. The primary route of infection, inhalation of airborne particles containing virus, is almost always associated with indoor environments.

Removal of rodent contamination from indoor areas will reduce the risk of personnel acquiring hantavirus infection. The level of contamination, the type of activity in the facility, and the type of personnel performing the cleanup operations will dictate the methods used and the personal protective measures to be taken. The goal of any cleanup operation is to remove rodent contaminants without exposing cleaning personnel to hantavirus-laden particles in the air or on their hands and bodies. The risk of coming into contact with hantavirus increases with the amount of contamination present and the type of cleanup required. Obviously, it is easier to clean up rodent droppings from a hard-surfaced floor than from carpet.

Figure 1. Stacked insulation.

Figure 2. Mouse urine and feces on insulation.

It is also easier to clean up droppings from the floor than from contaminated furniture or other equipment. For example, the rodent-contaminated stacks of insulation shown in Figures 1 and 2 will have to be moved out of the building for disposal. The handling and movement of this material will increase the airborne virus hazard as well as contact with the hands. For this reason, additional precautions will have to be taken when cleaning up this building.

Since hantavirus infection is acquired primarily by inhaling rodent contaminants, protection of the individual's breathing zone is the first line of defense against disease. Wearing a respirator

with N100 (HEPA) cartridges will stop particulates containing virus from entering the airway. However, not everyone should be fit-tested for a respirator when cleaning up rodent contamination. For example, light infestations that can be sprayed and cleaned up without otherwise disturbing the droppings should not pose an airborne hazard. However, cleanup of larger amounts of contaminants that will most likely be aerosolized during the cleanup operation requires respirator use.

The second route of infection is through ingestion. This happens when virus particles from rodent urine or feces enter the mouth. Rubber or plastic gloves should be worn on the hands of all individuals cleaning up rodent contamination, even when only disposing of a mouse caught in a trap. When the cleanup is finished, the gloves can be washed with disinfectant or soap and water. The gloves may be reused or discarded in the trash, but only after they have been disinfected on the outside. Wash hands with soap and water when cleanup is finished. For cleanup operations that are likely to result in rodent contaminants contacting the body, coveralls should be worn. These may be disposable or washable. All coveralls should be sprayed with disinfectant before removal from the cleanup site to prevent contamination of vehicles, offices, or other areas where the coveralls are kept. Coveralls should be taped to the gloves at the cuffs and to the legs at the ankles in order to prevent contaminants from entering sleeve or leg openings.

<u>The procedures listed below should be followed when cleaning up rodent contamination</u>.

All personnel involved in cleaning should wear protective clothing and equipment. Depending on the level of contamination, this may include fit-tested respirators with N-100 (HEPA) cartridges, goggles, solvent-resistant gloves, coveralls, and boots.

Spray the floors and those portions of the building's walls that show evidence of rodent activity with a disinfectant formulated to kill viruses. 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 into a plastic bag. Use double bags when heavy rodent contamination is encountered. Depending on the amount of contamination, use a wet paper towel, mop, or shovel to remove the soaked material. Seal the plastic bags(s) when full or when the cleanup is completed, and spray the outside of the bags with disinfectant. For light to moderate rodent contamination, small bags containing disinfected materials may be wrapped in newspaper and then placed in a dumpster. Follow local installation disposal procedures, but generally, larger double bags of contaminated material may also be placed in a dumpster or other approved waste receptacle. Do not attempt to remove dry contaminated materials by sweeping or with a vacuum, even if it is equipped with a HEPA filter.

Mop all hard-surfaced floors with water containing a general-purpose disinfectant and detergent. Spray dirt floors with a general-purpose disinfectant and wait the manufacturer-specified dwell time before use. Clean carpets and upholstered furniture with commercial-grade cleaning equipment. 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. A special note about carpet: Light rodent contamination can be sprayed with disinfectant and cleaned up with a wet paper towel. The area

should then be resprayed with disinfectant and air-dried. For heavier contamination, the droppings should first be sprayed with disinfectant and removed with a shovel or mop, after which the carpet should be cleaned with a carpet-cleaning machine containing hot water and disinfectant.

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

Launder contaminated clothing and bedding in hot water and detergent. Items that cannot be laundered may be dry cleaned.

The various cleanup scenarios presented in the following text boxes illustrate the level of contamination, the cleanup methods, and the personal protection required. This information should be used as a general guide, subject to modification or change by Public Health personnel. Examples of light and heavy rodent contamination are shown in Figures 3 and 4.

Figure 3. Light rodent contamination.

Figure 4. Heavy rodent contamination.

Common Scenarios for Cleanup of Rodent Contamination

The methods described below address some of the more common scenarios involving rodent contamination on military installations. If questions arise when considering any of these scenarios, or if the cleanup operation does not fit into any of the listed categories, local Public Health personnel should be contacted for advice. Public Health should also be consulted whenever any major cleanup operation is undertaken.

Scenario 1:

Personnel Involved: Any personnel.

Level of Rodent Contamination: Dead mouse in trap.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, 1-gallon size plastic bag, newspaper, and rubber or plastic gloves (optional).

Cleanup Method: Spray the mouse and trap with disinfectant until wet. Turn the bag inside out. With the hand inside the bag, pick up the mouse and trap together. Invert the bag over the hand and seal the bag. Wrap the bag in newspaper and place it in a dumpster or garbage can. Spray the area where the trap was removed with a light amount of disinfectant and let dry. If gloves were worn to pick up the trap, spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water.

Scenario 2:

Personnel Involved: Family Housing and Barracks Occupants.

Level of Rodent Contamination: Light to moderate. Rodent droppings found inside home or barracks room only along walls, not in traffic areas. Number of droppings per square foot should not exceed 20.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, rubber or plastic gloves, paper towels, plastic bag, and newspaper.

Cleanup Method: Put on the gloves. Open windows and doors in the rodent-contaminated room and air out for 30 minutes. Spray disinfectant on the area containing rodent droppings until wet, whether hard surface or carpet. Wet a paper towel and wipe up the droppings. Place the wet towels and droppings into the plastic bag. Seal the bag, wrap in newspaper, and place in a dumpster or garbage can. Respray the contaminated area with a light amount of disinfectant and let dry. Spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water.

Scenario 3:

Personnel Involved: Family Housing and Barracks Occupants.

Level of Rodent Contamination: Heavy contamination. Rodent droppings found throughout the room or storage area. Furniture, boxes, and other items contaminated with droppings or urine.

Protective Clothing and Equipment: See instructions in Box 11.

Cleanup Method: Call Public Health for onsite evaluation. Cleanup will require trained, fully protected workers.

Scenario 4:

Personnel Involved: Workers in bunkers, warehouses, motor pools, ranges, or other industrial buildings.

Level of Rodent Contamination: Light to moderate. Rodent droppings found only along walls, not in traffic areas. Number of droppings per square foot should not exceed 20.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, rubber or plastic gloves, paper towels, plastic bag, and newspaper.

Cleanup Method: Put on the gloves. Open windows and doors in the rodent-contaminated room and air out for at least 30 minutes. Spray disinfectant on the area containing rodent droppings until wet. Wet a paper towel and wipe up the droppings. Place the wet towels and droppings into the plastic bag. Seal the bag, wrap in newspaper, and discard in a dumpster or garbage can. Respray the contaminated area with a light amount of disinfectant and let dry. Spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water.

Note: These types of buildings do not usually contain carpet. However, if carpet is contaminated, the same procedures mentioned above should be followed as long as the contamination is limited. These procedures are for cleanup of light to moderate contamination only. If equipment, boxes, or materials other than floor space are contaminated, or the floor (including carpet) is heavily contaminated, then cleanup will require trained, fully protected workers**.** See instructions in Box 11 and call Public Health for onsite evaluation.

Scenario 5:

Personnel Involved: Workers in offices, break areas, and other administrative buildings.

Level of Rodent Contamination: Light to moderate. Rodent droppings found only along walls, not in traffic areas. Number of droppings per square foot should not exceed 20.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, rubber or plastic gloves, paper towels, plastic bag, and newspaper.

Cleanup Method: Open windows and doors in the rodent-contaminated room and air out for 30 minutes. Spray disinfectant on the area containing rodent droppings until wet, whether hard surface or carpet. Put on the gloves. Wet a paper towel and wipe up the droppings. Place the wet towels and droppings into the plastic bag. Seal the bag, wrap in newspaper, and place in a dumpster or garbage can. Respray the contaminated area with a light amount of disinfectant and let dry. Spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water.

Note: These procedures are for cleanup of light to moderate contamination only. If equipment, boxes, or materials other than floor space are contaminated, or the floor is heavily contaminated, then cleanup will require trained, fully protected workers**.** See instructions in Box 11 and call Public Health for onsite evaluation.

Scenario 6:

Personnel Involved: Electricians servicing utility boxes.

Level of Rodent Contamination: Light to moderate. Most rodent droppings found in bottom of utility box. Less than 20 droppings found on tops of panels in box.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, half- face respirator with N-100 cartridges, and rubber or plastic gloves.

Cleanup Method: Put on the respirator and rubber or plastic gloves before opening the doors to the utility box. Leave the doors open for 30 minutes. Disconnect power to the box. Spray any rodent droppings, urine, or nesting materials until wet. Spray the outside of the gloves with disinfectant. At this point, the respirator and the rubber or plastic gloves may be removed and work gloves may be put on. Complete work and close the box.

Scenario 7:

Personnel Involved: Personnel cleaning out electrical utility boxes.

Level of Rodent Contamination: Heavy contamination. Rodent droppings found throughout the box. Nesting materials and numerous droppings in the bottom of the box.

Protective Clothing and Equipment: Half-face respirator with N-100 cartridges or PAPR, coveralls, rubber or plastic gloves taped to the coveralls at the wrists, non-vented eye goggles, and rubber or plastic boots.

Cleanup Method: Put on all protective equipment before opening the doors to the box. Leave the doors open for at least 30 minutes. Disconnect power to the box. Spray the contaminated surfaces until wet with disinfectant using a 2-gallon sprayer or other device that minimizes dust. Use scrapers or wet cloth to remove the contaminants. Place contaminants into a plastic bag. Respray the box a second time with disinfectant and air dry. Remember to dispose of the contaminated cloth wipes in the same manner as the cleaned up contaminants. More detailed guidance on decontamination of workers following cleanup can be obtained from the local Public Health office.

Scenario 8:

Personnel Involved: Stables personnel.

Level of Rodent Contamination: Light to moderate. Rodent droppings found inside tack rooms and storage rooms are only along walls, not in traffic areas. Number of droppings per square foot should not exceed 20.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, rubber or plastic gloves, paper towels, plastic bag, and newspaper.

Cleanup Method: Put on the gloves. Open windows and doors in the rodent- contaminated room and air out for 30 minutes. Spray disinfectant on the area containing rodent droppings until wet. Wet a paper towel and wipe up the droppings. Place the wet towels and droppings into the plastic bag. Seal the bag, wrap in newspaper, and discard in a dumpster or garbage can. Respray the contaminated area with a light amount of disinfectant and let dry. Spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water.

Scenario 9:

Personnel Involved: Stables personnel.

Level of Rodent Contamination: Heavy contamination. Rodent droppings found throughout the tack room or storage area. Boxes and other items contaminated with droppings or urine.

Protective Clothing and Equipment: See instructions in Box 11.

Cleanup Method: Call Public Health for onsite evaluation. Cleanup will require trained, fully protected workers.

Scenario 10:

Personnel Involved: Vehicle maintenance personnel.

Level of Rodent Contamination: Light to moderate contamination. Rodent droppings or nesting materials present on seats and floors in the cabs, in heater vents and glove boxes, and on engine blocks. No more than 10 droppings per square foot.

Protective Clothing and Equipment: 1 can or spray bottle of disinfectant, rubber or plastic gloves, paper towels, plastic bag, and newspaper.

Cleanup Method: Put on the gloves. Open all external doors and windows to the cab; open the engine compartment and air out for 30 minutes. Spray disinfectant on the area containing rodent droppings until wet. Wet a paper towel and wipe up the droppings. Place the wet towels and droppings into the plastic bag. Seal the bag, wrap in newspaper, and discard in a dumpster or garbage can. Respray the contaminated area with a light amount of disinfectant and let dry. Spray the outside of the gloves with disinfectant. Remove gloves and wash hands with soap and water. If rodent droppings are found in the heater vents, spray those portions of the vents accessible from the cab. When cleanup is over, start the engine, turn the heater on to low, and, from the outside of the vehicle, spray the disinfectant into the heater vent intake for 30 seconds. Shut off the heater vent and engine and leave the vehicle doors and windows open for 30 minutes.

Note: When heavy rodent contamination is encountered, call Public Health for onsite evaluation. Cleanup will require trained, fully protected workers.

Scenario 11:

Personnel Involved: Rodent cleanup team members.

Level of Rodent Contamination: Heavy contamination. Rodent droppings, urine, or nesting materials present throughout the area. Area to be cleaned may be hard surfaced or carpeted.

Protective Clothing and Equipment: Half-face respirator with N-100 cartridges or PAPR, coveralls, rubber or plastic gloves taped to coveralls at the wrists, non- vented eye goggles, and rubber or plastic boots.

Cleanup Method: Put on all protective clothing and equipment. Open all external doors and windows. Spray the contaminated surfaces until wet with disinfectant using a 2-gallon sprayer or other device that minimizes dust. Use a shovel or wet mop to remove the contaminants -- never use a broom. Place contaminants into a plastic bag. Mop the floor a second time with disinfectant and air dry. Carpet should be cleaned with a carpet cleaning machine containing hot water and disinfectant. Remember to dispose of the mop head(s) in the same manner as the cleaned up contaminants. More detailed guidance on decontamination of workers following cleanup can be obtained from the local Public Health office.

Note: This is a brief overview of cleanup procedures for substantial amounts of rodent contamination. Detailed instructions and safety briefings will be coordinated with Public Health prior to the time cleanup operations commence.

Afterword

The first edition of this Technical Guide, published in April 1999 as *Protection from Rodent-borne Diseases with Special Emphasis on Occupational Exposure to Hantavirus*, was prepared by Mr. Frederick J. "Jim" Harrison, Jr. of USACHPPM-West, with the expert assistance of Mr. William E. Irwin of USACHPPM-West, who provided information on hantavirus surveillance, Dr. Brian Hjelle of the University of New Mexico School of Medicine, who provided guidance and information on hantaviruses in the Americas, and members of the AFPMB Rodent and Tick-Borne Disease Subcommittee and the AFPMB staff. MAJ Richard N. Johnson of the Defense Pest Management Information Analysis Center (DPMIAC) provided final editing and publication preparation.

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This 2020 version was reviewed and updated by experts from the California Department of Public Health. Mr. Terry Carpenter of the AFPMB Strategy and Information Division provided coordination and final editing and publication preparation.

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