

Guidelines for Handling Animal Reservoirs of Hantaviruses

**Recommended Field Research Practices for Employees of
the University of California, Berkeley**

August 2005

These guidelines are based on practices recommended by the Centers for Disease Control and Prevention (CDC) in areas known to have produced fatal human cases of Hantavirus Pulmonary Syndrome (HPS). The guidelines have been modified by the University of California, Berkeley (UC Berkeley) to address fieldwork in areas of undefined risk, and to educate employees on how best to protect against hantavirus infection in the field. The guidelines are reissued as additional information about fieldwork practices and the epidemiology of hantaviruses becomes available.

The Office of Environment, Health & Safety (EH&S) can help adapt these guidelines to specific fieldwork and determine the most appropriate protective measures for individual projects. Please contact EH&S or the Animal Care and Use Committee (ACUC) with comments or suggestions about the guidelines. (See “Resources,” page 7)

SCOPE

These guidelines are restricted to the handling of animal reservoirs of the types of hantavirus that cause Hantavirus Pulmonary Syndrome (HPS) in the contiguous United States. For field researchers working outside the contiguous United States, there are additional reservoirs of types of hantavirus that cause HPS in South America. Additionally, hantaviruses in other parts of the world, notably Asia and Europe, cause a separate fatal syndrome, Hemorrhagic Fever with Renal Syndrome.

BACKGROUND

What is Hantavirus?

Hantaviruses are a group of viruses that can be carried by certain rodents. Some hantaviruses cause a potentially fatal viral infection called Hantavirus Pulmonary Syndrome (HPS).

Carriers

Rodents are the only known reservoirs of hantaviruses. Other small mammals can be infected as well, but are much less likely to transmit the virus to other animals or humans. The CDC reports that while antibodies to hantaviruses are found in numerous other species of rodents and their predators, no evidence supports the transmission of infection to other animals or to humans from the “dead-end” hosts.

The recommendations in this document are intended for work involving populations of rodents that can be persistently infected with the types of hantavirus that cause HPS and shed those viruses.

In California, the only rodent species known to carry the type of hantavirus that causes HPS is the deer mouse:

Deer mouse (*Peromyscus maniculatus*) The deer mouse, found in most of the United States and commonly throughout California, carries the Sin Nombre virus (SNV) and is

the most common carrier of HPS. Deer mice are four to seven (4-7) inches long. They are gray to brown on top and white underneath, and have large, unfurred ears.

Other rodent species in the U.S. known to persistently carry the types of hantavirus strains that cause HPS include:

Cotton rat (*Sigmodon hispidus*) Found in the southeastern and south-central U.S., the cotton rat carries the Black Creek Canal virus (BCCV).

Rice rat (*Oryzomys palustris*) Native to the southeastern and south-central U.S., the rat is host to the Bayou virus.

White-footed mouse (*Peromyscus leucopus*) and Cloudland deer mouse (*Peromyscus maniculatus nubiterrae*) Found throughout the eastern and central portions of the U.S., they carry, respectively, the New York virus and the Monongahela virus, two subspecies of the Sin Nombre virus.

Other rodents may persistently carry hantavirus strains that cause HPS, but none has yet been identified.

Transmission

Hantavirus carriers can persistently or intermittently shed the virus in their urine, droppings, and saliva. Humans can acquire the virus

- by inhaling aerosolized droplets containing the virus (most commonly);
- through broken skin or mucous membranes;
- from rodent bites; or
- by accidental ingestion of rodent excreta or contaminated material.

There is no record of person-to-person transmission of HPS in the United States.

Although 70 percent of HPS cases in the United States have occurred in rural areas, rodents in suburban or urban areas should be considered potentially affected.

Risk Factors

People who come in contact with rodents or with their droppings, urine, saliva, or nesting materials are at risk of contracting HPS. This includes, but is not limited to, mammalogists, field biologists, pest-control workers, and residents who live in rural or semi-rural settings inhabited by known rodent reservoirs.

Hantavirus infection has been associated with the following situations:

- Increasing numbers of host rodents in human dwellings.
- Occupying or cleaning previously vacant cabins or other dwelling that are actively infested with rodents; high risk of exposure has been associated with entering of cleaning rodent-infested structures.
- Cleaning barns and other outbuildings.
- Disturbing excreta or rodent nests.
- Residing in or visiting areas where substantial increases have occurred in numbers of host rodents or numbers of hantavirus-infected host rodents.

- Handling mice without gloves.
- Keeping captive wild rodents as pets or research subjects.
- Handling equipment or machinery that has been in storage.
- Disturbing excreta in rodent-infested areas while hiking or camping.
- Sleeping on the ground.
- Hand plowing or planting.

The likelihood of infection with hantavirus is low; however, about 400 cases have been confirmed in the United States since the disease was first described in 1993.

The fatality rate for HPS is approximately 36 percent. In California, 43 cases of HPS had been reported as of May 2005, 15 of which were fatal. At present there is no effective vaccine to prevent infection. Treatment is difficult, but more effective with early diagnosis.

GENERAL PRACTICES

It is the responsibility of each individual working in areas of potential risk to take appropriate protective measures against contracting hantavirus. It is the responsibility of the supervisor to determine the level of risk for HPS in each work setting, ensure training, and provide appropriate protections.

Training and Guidelines

1. Workers in potentially high-risk settings should receive a thorough orientation about hantavirus transmission and the symptoms of the disease. They should be given detailed guidance on prevention measures and trained to safely perform the required activities. This information should be provided by the Principal Investigator or supervisor. EH&S can also provide training, if requested.
2. The Animal Handlers Medical Surveillance Program is available at the campus Occupational Health Clinic for all individuals whose work involves frequent animal contact or who have special health concerns (allergy, infectious disease risk) related to their animal exposures. Before beginning work in the field, please contact the clinic for an appointment (642-6891).
3. Workers performing procedures with a high risk of contacting animal body fluids or creating aerosols, such as removing organs or obtaining blood from rodents in an affected area, should contact EH&S for detailed safety precautions.

General Precautions for Fieldworkers

1. Practice good personal hygiene at all times. Wash hands with soap and water or with a disinfectant wipe before eating, drinking, smoking, or applying lip balm, sunscreen, or cosmetics.
2. Wear rubber, latex, or nitrile gloves when handling rodents or traps contaminated by rodents, or when you have broken skin. Glove choice should be based on specific tasks and personal preference; for example, nitrile may be chosen due to latex allergy. Before removing the gloves, wash gloved hands in a disinfectant. (Many gloves have poor resistance to disinfectant chemicals and should be removed shortly after exposure to a

disinfectant.) Thoroughly wash hands with soap and water after removing gloves. If this is not possible, then rinse gloves with water or use a disinfectant wipe. Wash your hands thoroughly at the end of the work period.

3. In the field, carry a spray bottle of disinfectant or hand-wipes containing alcohol or detergent. CDC recommends making fresh 10-percent solutions of household bleach (one part bleach, nine parts water) daily. (See “Disinfectants,” below)
4. Disinfect all traps contaminated by rodent urine or feces, or in which a rodent was captured, by soaking traps in the disinfectant for at least 10 minutes. If this is not done until the end of the trapping run, wear a respirator whenever handling contaminated traps, and transport or store empty traps in closed double plastic bags.
5. Consult EH&S to determine the need for respiratory protection. Work practices and risks of exposure will be analyzed to make a determination as to what type of respirator is appropriate. You may be asked to undergo medical clearance before being approved to use a respirator.
6. In populated areas, dispose of dead rodents by placing the carcasses in double plastic bags containing enough disinfectant to thoroughly wet the carcasses. Seal the bag and dispose of it in the regular trash, as long as the trash is regularly emptied.
7. Do not enter enclosed spaces of buildings visibly contaminated with rodents or rodent droppings. Contact the facility manager or EH&S for assistance.

Respirators

Workers may need to wear respirators when handling field-caught rodents or contaminated traps, or when disturbing rodent burrow and nests. Contact EH&S for an evaluation of work practices and for information about the Respiratory Protection Program (642-3073).

The proper use of respirators provides protection against airborne particles of rodent excreta – the presumed cause of most hantavirus infections. However, the incorrect use or care of respirators may increase, rather than decrease, risk of exposure to harmful agents. Use of respirators is NOT advised if, due to the nature of the fieldwork, they cannot be kept sanitary.

Additionally, respirators must be used only under the guidance of the Respiratory Protection Program, administered by EH&S and the Occupational Health Clinic.

The recommended respiratory protection for hantavirus is a half-face or full-face air-purifying (negative-pressure) respiratory with HEPA (N-100) filters or a Powered Air-Purifying Respirator (PAPR) equipped with HEPA (N-100) filters. EH&S will evaluate alternative types of HEPA-filter masks for acceptability on a case-by-case basis.

Disinfectants

Hantaviruses are lipid-enveloped viruses, susceptible to most disinfectants, including dilute hypochlorite solutions (10-percent solution of household bleach; one part bleach to nine parts

water), 70-percent alcohol, phenolic disinfectants, quaternary ammonium compounds, and most general-purpose household disinfectants commercially available in the United States – as long as the label states that it is a disinfectant and it is prepared according to the label. The virus can probably survive up to one week indoors, but much less (perhaps only hours) when exposed to sunlight outdoors.

In Case of Infection

Workers who develop HPS symptoms within one to five weeks of potential exposure should seek immediate medical attention. Early symptoms of HPS include fatigue, fever, and muscle aches. Some people experience headaches, dizziness, chills, and abdominal problems. Late symptoms appear four to 10 days after early symptoms, and include coughing and shortness of breath. Inform the physician of the occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected.

The worker's supervisor should contact EH&S if it is suspected by a physician that the illness may be HPS and that it was acquired in the workplace. The Occupational Health Clinic is also available to assist individuals with the concerns (642-6891). If appropriate, a blood sample may be sent to the California Department of Health Services (DHS) for hantavirus antibody testing.

SPECIFIC PRACTICES

The following information is intended to give an overview of recommended precautions for specific work practices. For more detailed information, please refer to the Center for Disease Control (CDC) publication, *Methods of Trapping & Sampling Small Mammals for Virologic Testing*. This publication is available for download (in PDF format) from the CDC Special Pathogen Branch's website at <http://www.cdc.gov/ncidod/dvrd/spb/mnpages/rodentmanual.htm>.

Visual Survey of Area – Walking, Hiking

No special personal protective equipment (PPE) is needed for protection against hantavirus infection. However, respiratory protection may be advisable in a known affected area that is visually contaminated by rodents or has especially dusty conditions. (See "Respirators," above)

Setting Trap Lines

When setting disinfected traps, wear a long-sleeved shirt, long pants, socks, and lace-up shoes. Respiratory protection and thick rubber gloves are recommended if the traps have not been disinfected since prior use.

Recovery and Transport of Traps Holding Live Animals

- Wear the protective clothing listed above, including thick rubber gloves. If using open-mesh traps, respiratory protection and eye protection are also recommended.
- Stand upwind from the trap, if possible. Select plastic bags large enough to ensure an adequate reservoir of air for the animal and thick enough to ensure the trap does not rip holes in the bag. Carefully place the trap into a bag, close the bag at the top

to maximize the air reservoir for the animal, and tie the bag closed. Repeat the procedure with a second bag. Do not open the bags until the proper PPE has been donned at the processing area. When transporting animals in an enclosed vehicle to a processing site, place the trapped animals in the bed of the truck or the trunk of the car to isolate them from the passenger compartment.

- If traps are not to be disinfected until the end of the project, store them in closed double plastic bags between uses. (See “Cleanup,” below)

Handling Live Animals

- When possible, anesthetize the animal before handling. Wear PPE, including a disposable gown or coveralls, disposable shoe covers, two pairs of latex or nitrile gloves, eye protection, and respiratory protection. Use appropriate handling methods to protect against both bites and urine contamination of the hands.
- Define a zone to exclude others who are not wearing appropriate protective equipment. Work with the wind at your back if possible. Perform all procedures in a manner that minimizes the creation of aerosols and dust.
- Remove the captured animal from the trap by shaking it into an anesthesia bag; or, alternatively, pinch the animal’s skin through the mesh of the trap with forceps and inject the anesthetic.
- If it is not possible or appropriate to use anesthesia, wear protective clothing as described and use appropriate restraining devices. Avoid creating aerosols.

Field Dissection

Field dissection is strongly discouraged. Instead, transport animals to a laboratory with appropriate containment equipment in order to process them under safer working conditions.

- If field dissection must occur, **wear PPE**, including two pairs of latex (or nitrile) gloves, eye protection, and respiratory protection. Surgical gowns and shoe covers are also recommended.
- Process the animals in an isolated area. Use the minimum number of workers to do the job safely. Define and mark a zone to exclude others not directly involved in the animal dissection. Work with the wind at your back, if possible.
- Perform all procedures carefully, to minimize the creation of aerosols. Use extreme caution with any contaminated sharp items, including needles, syringes, slides, pipettes, capillary tubes, and scalpels. Use engineered sharps or injury-protection devices if available for the specific process. Substitute plastic labware for glass whenever possible.
- Use hypodermic needles and syringes only for gavage, parenteral injection, or aspiration of fluids from diaphragm bottles or well-restrained animals. Use only needle-locking syringes or disposable syringe-needle units. Do not bend, shear, break, recap, or otherwise manipulate needles by hand before disposal; place

used disposable needles and other sharps in a conveniently located puncture-resistant sharps container. Before the container is full, lid it tightly or tape it closed, place it into a double plastic bag, and clean off the surface of the bag before disposal as medical waste. Place non-disposable sharps in a hard-walled closable container, preferably containing a suitable disinfectant. Do not handle broken glassware directly; use mechanical means such as a brush and dustpan, tongs, or forceps.

- Place the tissues or specimens of body fluids in a container that prevents leakage during collection, handling, processing, storage, transport, or shipping. Carcasses may be preserved and transported in 10-percent formalin, dry ice, or liquid nitrogen.
- Dispose of unwanted carcasses in double plastic bags containing enough disinfectant to thoroughly wet the carcasses; seal the bag and dispose of it in the regular trash, as long as the trash is regularly emptied.

Cleanup

(See “Disinfectants,” above)

- Wear thick rubber gloves when disinfecting contaminated traps. The ideal method is to submerge the traps in a bucket of disinfectant for 10 minutes, rinse twice with water, and set in the sun to dry. Alternatively, spray the traps with disinfectant.
- Place used instruments into disinfectant for 10 minutes.
- Decontaminate all wastes appropriately before disposal. Contact EH&S if you need help developing a procedure.
- Remove disposable protective clothing outdoors or in a well-ventilated area, and put clothing in plastic bags for disposal.
- If personal clothing become visibly contaminated with rodent urine, droppings, or saliva, place (with minimal agitation) into a plastic bag, tie the bag closed, and contact EH&S for laundering procedures.
- Wash hands thoroughly with soap and water.

Additional Precautions

Establish practical and effective protocols for handling emergency situations, and for conditions particular to your project.

RESOURCES

Office of Environment, Health & Safety (EH&S)

General Information:

Address: 317 University Hall
Website: <http://www.ehs.berkeley.edu>
Phone: 642-3073

Specific hantavirus questions and protective measures:

Sara Souza
Research Health & Safety Specialist
Phone: 643-5809
Email: sarasouza@berkeley.edu

Sonia Rosenberger
Biosafety Officer
Phone: 643-6562
Email: srosen@berkeley.edu

Respiratory Protection Program:

Brigitte Bankay
Respiratory Program Manager
Phone: 642-1977
Email: Bbankay@berkeley.edu

University Health Services – Occupational Health Clinic

Carole Plum, RN, NP, COHN-S
Phone: 642-6891
Email: cplum@uhs.berkeley.edu

Diane Liu, MD, MPH
Phone: 642-6891

Pest Management

Margaret Hurlbert
Phone: 642-0878
Email: hurlbert@berkeley.edu

California Department of Health Services (DHS)

Infectious Disease Branch:

Website: <http://www.dhs.ca.gov/ps/dcdc/disb/disbindex.htm>

REFERENCES

1. Mills JN, Corneli A, Young JC, Garrison LE, Khan AS, Ksiazek TG. Hantavirus pulmonary syndrome – United States: updated recommendations for risk reduction. Centers for Disease Control and Prevention. *MMWR Recomm Rep.* 2002 Jul 26; 51 (RR-9): 1-12.
<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5109a1.htm>
2. Lednicky JA. Hantaviruses: a short review. *Arch Pathol Lab Med.* 2003 Jan; 127(1): 30-5.
3. Centers for Disease Control and Prevention. *Methods of Trapping & Sampling Small Mammals for Virologic Testing*, Sept. 1995, Atlanta, Georgia
<http://www.cdc.gov/ncidod/dvrd/spb/mnpages/rodentmanual.htm>