

## History

A type of hantavirus (pronounced *hūntavīrus*) struck thousands of United States and United Nations soldiers during the Korean War. A similar virus gained U.S. attention Memorial Day weekend in 1993 when several young adult Navajo Indians died in the Four Corners region where New Mexico, Arizona, Utah, and Colorado meet.

Different types of the hantavirus affect 200,000 people a year worldwide. Most of the victims are found in Asia and Europe. The virus strain which causes flu-like symptoms kills its victims 5 to 15

percent of the time in Asia and just 1 percent in Europe. The deaths in Asia and Europe are from kidney hemorrhage instead of fluid buildup in the lungs which occurs here in the U.S. The death rate in the U.S. has dropped from 66 percent of the victims to 50 percent.

Some have asked why hasn't this disease shown up before? Scientists feel that it has been with us for many years. Deaths from the disease in the past have probably been diagnosed as respiratory failure.

The Four Corner deaths have been attributed to heavy rains which produced an unusually rich crop of wild pinon nuts. The large pinon nut supply triggered a mouse-population explosion (*Time*, December 6, 1993). Scientists may be able to tie our heavy rain to a mouse-population explosion which in turn is bringing an unusually large number of infected mice and amount of mice droppings into contact with humans.

Now that scientists are aware that the disease is in the United States, more information can be gathered to determine the number of deaths, proper

# Hantavirus

Michael H. Bradshaw  
Extension Specialist  
Health and Safety

Department of Human Development and Family Studies

incidental contact with rodents or their habitations in the affected areas. Some occupations which may be at greater risk include: farmers, grain elevator workers, ranchers, telephone installers, maintenance workers, plumbers, electricians, and certain construction workers.

Workers in these jobs may have to enter buildings, crawl spaces, or other sites that may be rodent infested. Recommendations for such circumstances must be made on a case-by-case basis after the specific working environment has been assessed and state or local health departments have been consulted.

treatment for victims, and development of a possible vaccine to prevent the disease in persons at greater risk of contracting the disease. Two or three deaths per year in a state the size of Kansas may be all that will be seen, but on the other hand, with better reporting there may be more.

What the threat is will not be known for a few years, but for now those who are at greater risk because of their occupation must be warned.

## Risk

Scientists believe the risk of individuals contracting the hantavirus is slight. Even though the risk may be slight, it is real.

Antibodies for the disease have been found in deer mice in southwest Kansas and in north central Kansas. With more testing, the virus is likely to be found in all counties of the state. Those who work where mice or mice droppings are found may want to take the precautions which are recommended in this fact sheet.

General recommendations have not been established for persons who work in occupations with unpredictable or

## Hantavirus Pulmonary Syndrome (Muerto Canyon Virus)

**Persons who contract the virus may experience one or more flu-like symptoms: fever, muscle aches, headaches, cough, nausea, vomiting, or diarrhea.** The fever associated with this disease ranges from 101° to 104°F and does not respond to medication. The disease may progress rapidly causing the lungs to fill with fluid, making it difficult to breath. Death from respiratory failure may occur in a matter of a few hours. The symptoms usually appear two to three weeks after exposure to the virus, but may take up to forty-five days.

## Host

Deer mice seem to be the primary reservoir host in the United States. Blood tests have shown that the pinon mice, brush mice, and western chipmunks have developed antibodies to the virus and are potential hosts of the disease.

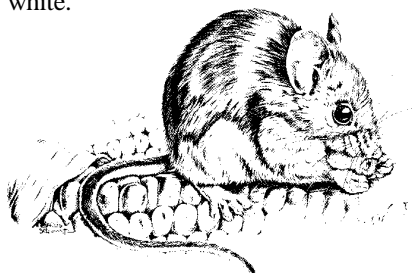
The hantavirus does not cause



obvious illness in rodents. Infected rodents shed the virus in saliva, urine, and feces for many weeks, but the duration and period of maximum infectivity are unknown.

#### **Treat all mice as potential hosts.**

The deer mouse is the most abundant of the twenty-three field rodents in Kansas. Most people are unable to distinguish one kind of mouse from another. One identifying feature of the deer mouse is its tail, which is short and finely haired with a well-defined dark stripe on top and white on bottom. The deer mouse is grey to brown with a white belly. It has short hind feet and all four feet are white.



*Deer Mouse*

Since June 6, 1993, antibodies to hantavirus have been detected in 23 percent of nearly 700 rodents trapped in the four corners area of New Mexico, Arizona, Utah, and Colorado.

Trapping and testing of deer mice in southwest Kansas found 6 percent with hantavirus antibodies. Sixteen rodents of other species trapped at the same location showed no antibodies for the virus.

Trapping south of Manhattan, Kansas, revealed no hantavirus antibodies in the fifty deer mice tested; however, 9 percent (17 of 201) of deer mice trapped in the area of Russell, Lincoln, and Osborne counties were found to have hantavirus antibodies.

## **Infection**

**Human infection may occur when infective urine, feces, or saliva are inhaled as aerosols from animals or animal waste.** People visiting laboratories where infected rodents were housed have been infected after only a few

minutes of exposure to the animal holding areas.

It is believed that transmission may also occur when dried materials (dust) contaminated by rodent droppings become airborne and are inhaled. The virus may also be introduced into broken skin, the eyes, or the mouth in contaminated food or water. Touching infected animals or animal waste and placing hands in the eyes, nose, or mouth may transfer the virus. People have also become infected after being bitten by infected rodents.

Ticks, fleas, mosquitoes, and other biting insects are not known to have a role in the transmission of hantaviruses.

**Person-to-person transmission has not been associated with any of the previously identified hantaviruses or with the recent outbreak in the Southwest or Kansas.**

Cats and dogs are not known to be reservoir hosts of hantaviruses in the United States. However, these domestic animals may bring infected rodents into contact with humans.

## **Infection occurrence**

Known hantavirus infections of humans are associated with domestic, occupational, or leisure activities that bring them into contact with infected rodents and rodent waste, usually in a rural setting. Cases have been associated with the following situations:

- Planting or harvesting field crops.
- Occupying previously vacant cabins or other dwellings.
- Cleaning barns and other outbuildings.
- Disturbing rodent-infested areas while working, hiking, or camping.
- Inhabiting dwellings with indoor rodent populations.
- Residing in or visiting areas in which the rodent population has shown an increase in density.

## **Precautions for Residents of Affected Areas**

### **Respiratory protection**

**Centers for Disease Control (CDC) has been recommending a NIOSH-**

**approved high efficiency, particulate air (HEPA) respirator for those who must work in or enter mice infested areas.** Those who must clean areas where mice or mice droppings are present may want to obtain a respirator with a HEPA filter.

The HEPA filter is available in cartridge respirators or disposable half-mask respirators. There are half-mask and full-mask, powered, air-purifying cartridge respirators. The cartridge must be a HEPA high-efficiency type which is color coded purple. A proper fit over the face is mandatory. This fit may not be possible for persons wearing beards or people who have facial features which prevent a good fit.

Those who wear a half-mask respirator will want to wear goggles to protect the eyes from dust. The full-mask respirator includes eye protection. The disposable HEPA respirator must be used with goggles, and requires a proper fit to function correctly. The HEPA respirator is 99.97 percent efficient and will remove particles that are 0.3 microns in diameter. A nuisance dust mask (single strap) is not very efficient and will only remove particles that are 10 microns or larger.

Cost of the disposable HEPA 3M 9970 or UVEX HEPA-Tech 3010 respirator or its equivalent will be approximately \$10. A half-mask cartridge respirator will cost approximately \$30. Cartridges will cost approximately \$10 for two.

Most respirators make added work for the heart and lungs. The amount of effort expended in doing a task may have to be reduced, or a respirator with an exhalation valve will be needed. Before buying a respirator, check with a physician to determine if medical conditions could limit respirator use. Persons having respiratory or cardiovascular impairment may not be able to use a respirator or may want to choose a respirator which has limited interference.

**Purchase of a HEPA respirator may be through local suppliers or by mail order.** A partial list of suppliers:

Zink Safety, Lenexa, KS, 1-800 255 1101; Gemplers, Mt. Horeb, WI, 1-800-382-8473; Lyons Safety, Denver, CO, 1-800-888-0667; Midcontinent Fire and Safety, Wichita, KS, 316-522-0900.

#### **Preventing entrance to the home:**

- Use steel wool or cement to seal, screen, or otherwise cover all openings or holes into the home.
- Place three inches of gravel in the crawl space under homes or mobile homes to discourage rodent burrowing.
- If you have continuing problems, place galvanized metal flashing as a rodent barrier around the base of wooden, earthen, or adobe dwellings, up to a height of twelve inches and buried in the soil to a depth of 6 inches.

#### **Reducing food sources and nesting sites inside:**

- Keep food (including pet food) and water covered and stored in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Store garbage in rodent-proof metal or thick plastic containers with tight-fitting lids.
- Wash dishes and cooking utensils immediately after use and remove any spilled food.
- Dispose of trash and clutter.

#### **Reducing shelter and food sources within 100 feet from the home:**

- Store grains, animal feed, and water in rodent-proof containers.
- Remove food sources, including pet dishes, that might attract rodents.
- Remove cut grass, brush, and dense shrubbery from within 100 feet of the home.
- Remove trash, old vehicles, and other items that may serve as rodent nesting sites.

A commercial rodenticide can be used effectively as an added preventative method. Place feeding stations under plywood, metal, or heavy plastic shelters raised about one inch off the ground. This keeps pets and children away from bait. Place bait stations near possible hiding and nesting areas around the home. Products used outdoors should carry specific label approval and instructions for exterior use.

### **Precautions for Campers and Hikers**

- Avoid coming into contact with rodents and rodent burrows or disturbing nests.
- Do not use cabins or other enclosed shelters that are rodent infested until they

have been appropriately cleaned and disinfected.

- If possible, do not sleep on the bare ground. Use a cot with sleeping bags in areas in proximity to rodent feces or burrows or near possible rodent shelters (e.g., garbage dumps, brush piles, or woodpiles).
- Keep food in rodent-proof containers.
- Promptly bury (or preferably burn followed by burying when in accordance with local requirements) all garbage and trash, or discard in covered trash containers.
- Use only bottled water or water that has been disinfected by boiling, chlorination, or iodination for drinking, cooking, washing dishes, and brushing teeth.

### **Eliminating Rodents Inside**

Rodent infestation can be determined by direct observation of animals or inferred from the presence of feces in closets or cabinets, on floors, or from evidence that rodents have been gnawing at food. If rodent infestation is detected inside the home or outbuildings, rodent elimination measures should be completed. [See the Special Precautions section if evidence of heavy rodent infestation (e.g., piles of feces or numerous dead animals) is present or if a structure is associated with a confirmed case of hantavirus disease.]

- Before rodent elimination work is begun, ventilate closed buildings or areas inside buildings by opening doors and windows for at least thirty minutes. Use an exhaust fan or cross ventilation if possible. Leave the area until the airing-out period is finished. This airing may help remove any aerosolized virus inside the closed-in structure.

- Second, seal, screen, or otherwise cover all openings into the structure that have a diameter of greater than or equal to 1/4 inch. Then set rodent traps using a good bait such as peanut butter or bacon. Use only spring-loaded traps that kill rodents.

- Next, treat the interior of the structure with an insecticide labeled for flea control; follow specific label instructions. Insecticide sprays or powders can be used in place of aerosols if they are appropriately labeled for flea control. Rodenticides may also be used while the interior is being treated, as outlined below. The flea is not known to transmit the hantavirus but it is a carrier of the plague. Once the mice are dead, a flea will look for another host which may be a human or a pet.

- Commercial rodenticides can be used in cleanup as an adjunct to trapping. Be certain to follow label instructions. Flea control should precede rodenticide use to reduce the risk of plague transmission. See the previous discussion on this page about placing rodenticide under shelters.

- Remove captured rodents from the traps. Wear rubber or plastic gloves while handling rodents. Place the carcasses in a plastic bag containing a sufficient amount of a general-purpose household disinfectant to thoroughly wet the carcasses. Seal the bag and then dispose of the bag by burying it in a two- to three-foot-deep hole or by burning. If burying or burning are not feasible, double-bag the material in plastic bags and dispose of them in a tightly covered trash container prior to trash pickup. Rebait and reset all sprung traps.

- Before removing the gloves, wash gloved hands in a general household disinfectant and then in soap and water. A hypochlorite solution (household bleach, 5 percent) prepared by mixing three tablespoons of household bleach (fresh) in one gallon of water may be used in place of a commercial disinfectant. When using the chlorine solution, avoid spilling the mixture on clothing or other items that may be damaged. Thoroughly wash hands with soap and water after removing the gloves.

- Leave several baited spring-loaded traps as a further precaution against rodent reinfestation. Examine the traps regularly. Disinfect traps no longer in use by washing in a general household disinfectant or the hypochlorite solution (household bleach). Disinfect and wash gloves as described above, and wash hands thoroughly with soap and water before beginning other activities.

### **Cleanup of Contaminated Areas**

*Note: The reader must judge the level of infestation and level of protection to be used in cleanup or other exposure to rodents or rodent waste. Those who are concerned about exposure to rodents or rodent waste may choose to wear a respirator, goggles, outer covering, and rubber or plastic gloves.*

Areas with evidence of rodent activity (e.g., dead rodents, rodent droppings) should be thoroughly cleaned to reduce the likelihood of exposure to hantavirus-infected materials. Cleanup procedures must be performed in a

manner that limits the potential for dirt or dust to become airborne from all potentially contaminated surfaces and household goods.

- Persons involved in the cleanup should wear rubber or plastic gloves.
- Spray dead rodents, rodent nests, droppings, foods, or other items that have been tainted by rodents with a general-purpose household disinfectant. Soak the material thoroughly, and place it in a plastic bag. Dispose of the bagged material by burying in a two- to three-foot-deep hole or by burning. A second method of disposal can be to double-bag the material in plastic bags and dispose of them in a tightly covered trash container prior to trash pickup.
- After the above items have been removed, mop floors with a solution of water, detergent, and disinfectant. Spray dirt floors with a disinfectant solution. A second mopping or spraying of floors with a general-purpose household disinfectant is optional. Carpets can be effectively sanitized with household disinfectants or by commercial-grade steam cleaning or shampooing. To avoid generating potentially infectious aerosols, do not vacuum or sweep dry surfaces before mopping.
- Disinfect countertops, cabinets, drawers, and other durable surfaces by washing them with a solution of detergent, water, and disinfectant, followed by an optional wiping-down with a general-purpose household disinfectant.
- Rugs and upholstered furniture should be steam cleaned or shampooed. If rodents have nested inside furniture and the nests are not accessible for decontamination, the furniture should be removed and burned.
- Launder potentially contaminated bedding and clothing with hot water and detergent. (Use rubber or plastic gloves when handling the dirty laundry; then wash and disinfect gloves as described in the section *Eliminating Rodents Inside the Home*.) Machine-dry laundry on a high setting or hang it to air dry in the sun.

## Special Precautions for Heavy Rodent Infestations

Special precautions are indicated in the affected areas for cleaning homes or buildings with heavy rodent infestations.

Persons conducting these activities should contact the responsible local, state, or federal public health agency for guidance. These precautions may also apply to vacant dwellings that have attracted numbers of rodents while unoccupied and to dwellings and other structures that have been occupied by persons with confirmed hantavirus infection.

Workers who are either hired specifically to perform the cleanup or asked to do so as part of their work activities should receive a thorough orientation from the responsible health agency about hantavirus transmission and should be trained to perform the required activities safely.

- A baseline serum sample, preferably drawn at the time these activities are initiated, should be available for all persons conducting the cleanup of homes or buildings with heavy rodent infestation. The serum sample should be stored at -20°C or -4°F.
- Persons involved in the cleanup should wear coveralls (disposable if possible), rubber boots or disposable shoe covers, rubber or plastic gloves, protective goggles, and an appropriate respiratory protection device, such as a half-mask, air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter, or a powered air-purifying respirator (PAPR) with HEPA filters. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator practices should follow a comprehensive user program and be supervised by a knowledgeable person.
- Personal protective gear should be decontaminated upon removal at the end of the day. If the coveralls are not disposable, they should be laundered on site. If no laundry facilities are available, the coveralls should be immersed in liquid disinfectant until they can be washed.
- All potentially infective waste material (including respirator filters) from cleanup operations that cannot be burned or deep buried on site should be double-bagged in appropriate plastic bags. The bagged

material should then be labeled as infectious (if it is to be transported) and disposed of in accordance with local requirements for infectious waste.

- Workers who develop a febrile or respiratory illness within forty-five days of the last potential exposure should seek medical attention immediately and inform the attending physician of the potential occupational risk of hantavirus infection. The physician should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained and forwarded with the baseline serum through the state health department to CDC for hantavirus antibody testing.

## Conclusion

The control and prevention recommendations in this fact sheet present general measures to minimize the likelihood of human exposure to the hantavirus. Many of the recommendations may not be applicable or necessary in unaffected locales. These recommendations are adapted from information supplied by the Centers for Disease Control. This material will be updated as more information is known.

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