General Knowledge: Hantavirus – An Update

Hantavirus – An Update Learning Objectives

After studying this section, you should be able to:

✓ List the rodents responsible for transmitting the different types of hantavirus
✓ Describe the symptoms of Hantavirus Pulmonary Syndrome or HPS
✓ Describe how hantavirus is transmitted
✓ Describe rodent control strategies to prevent HPS disease
✓ Describe the treatment for HPS disease

What is Hantavirus?

In May 1993, a cluster of unexplained deaths in the Four Corners area of the southwestern United States led to the discovery of a previously unrecognized disease. This disease, Hantavirus Pulmonary Syndrome (HPS), is caused by a previously unknown hantavirus, the Sin Nombre virus.

Though newly discovered in the southwest, hantaviruses are not new. During the Korean War, over 3,000 United Nations troops contracted hemorrhagic fever with renal syndrome (HFRS), a disease caused by a strain of hantavirus. There is evidence that HFRS was known as early as 960 A.D. in China.

Although it was discovered in 1993, the Sin Nombre virus is not new in the United States. By November 3, 1994, 95 cases of HPS were diagnosed, with some of the cases diagnosed from the saved blood of people who died from unknown causes. Two died in 1959. As of December 31, 2011, 587 cases had been reported in the United States. Unfortunately, of these 587 cases, 36% resulted in death. The virus has been present long enough to differentiate into subtypes or strains. Using RNA analysis, the Center for Disease Control has determined, for example, that an Arizona resident died from HPS that he contracted in Colorado. A closely related strain, the Black Creek Canal virus, causes HPS in the Southeast.
Hantaviruses are maintained in nature in a reservoir species, an animal that carries and spreads the virus without being affected by the virus themselves.

In Nevada, the deer mouse is the reservoir species for the Sin Nombre virus, the hantavirus common to our area.

Hantaviruses are maintained in nature by a reservoir species, usually a rodent, that carries the virus but does not contract the disease. Once infected, the reservoir species probably carries the virus for the rest of its life and sheds it in feces, urine and saliva. This appears to be the case for deer mice (Peromyscus maniculatus), the reservoir species for the Sin Nombre hantavirus. There have been thousands of deer mice trapped and tested for hantavirus in the U.S. since the 1993 outbreak. As the age of the deer mice increases, as indicated by body weight, the percent found positive for hantavirus also increases. Non-reservoir species may carry the virus to a lesser extent and for shorter periods.

There are four rodents that carry different strains of hantavirus in the United States that can affect humans:

- The deer mouse (Peromyscus maniculatus) is the reservoir species for the Sin Nombre strain of hantavirus. The deer mouse is a small rodent, 2 to 3 inches in body length and another 2 to 3 inches of tail, with large eyes and ears. While the body color can vary from gray to reddish-brown, the underbelly and feet are always white. The tail is fur-covered and white on the underside. The deer mouse is found throughout North America. Deer mice and house mice (Mus musculus) are similar looking but have characteristics that enable them to be differentiated. Deer mice have white hair on their belly, legs, and feet. Their tail has short hair that is bicolored, or dark on the top and white on the sides and bottom. The house mouse has a tail that is scaly, with few hairs. The belly of a house mouse is lighter than its back and sides but a house mouse does not have a white belly, feet, and legs. Deer mice have no odor, whereas house mice have a musty odor. Deer mice have larger ears and eyes than house mice.

- The cotton rat (Sigmodon hispidus) is the reservoir species for the Black Creek Canal strain of hantavirus. The head and body of the cotton rat measure 5 to 7 inches long, with another 3 to 4 inches of tail. The fur is long and coarse and can be grayish-brown to grayish-black. The cotton rat is native to the Southeastern United States, Central America and South America. It generally inhabits overgrown areas with shrubs and tall grasses.

- The rice rat (Oryzomys palustris) is the reservoir species for the Bayou strain of the hantavirus. The head and body measure 5 to 6 inches long, with a very long 4 to 7 inches of tail. The fur is short and soft and grayish-brown in color. The underbelly is gray or tawny brown. The feet are whitish colored. The rice rat is native to the Southeastern United States and Central America. It generally inhabits marshy areas and is semi-

To date, 587 cases have been reported in the United States, with a 35% death rate.
• The white-footed mouse is the reservoir of the New York strain of the hantavirus. The head and body measure 4 inches long. The tail is shorter than the body length, generally 2 to 4 inches long. The body fur is pale to reddish brown. The underbelly and feet are white, as the name implies. The tail is furred. It resembles the deer mouse, but generally the tail is shorter than the body length. The white-footed mouse is native to southern New England, the mid-Atlantic, Midwest and western states of the United States, and Mexico. It generally inhabits wooded and brushy areas, but will inhabit more open ground.

Another strain, the Prospect Hill strain of the hantavirus, was identified in meadow voles in the northeastern United States, but has not been shown to cause disease in humans.

The oral history of the Navajo Indians suggests that deer mice and people should not be together because deer mice cause sickness. They further say that in 1918, 1933 and 1934, rain provided for large pine nut crops that resulted in high populations of deer mice, causing deaths in young healthy Navajo Indians.

Since the 1993 outbreak, the Nevada Division of Health, along with other cooperating agencies, has conducted state surveys to gather information about hantavirus in Nevada. About 12 percent of the sampled mice have tested positive for hantavirus. In California, 11 percent of the deer mice tested are positive. Hantavirus can be found to some extent in deer mice populations throughout most of Nevada, regardless of elevation.

Fortunately, HPS is very difficult to contract. Since the disease was discovered in 1993, the Centers for Disease Control have collected blood from over 10,000 people who are at risk of coming into contact with infected deer mice. These people include biologists, mammalogists and animal handlers. About one percent carried antibodies to hantavirus.

**Symptoms of Hantavirus**

The symptoms of Hantavirus Pulmonary Syndrome are not specific to HPS. However, there are some characteristic patterns to look for and be aware of:

• Fever, fatigue and muscle ache of large muscle groups (thighs, hips, back and sometimes shoulders) occur in all cases.

• Headaches, dizziness and chills occur in about half the cases.

• Abdominal pain, nausea, vomiting, and/or diarrhea occur in about half of the cases.

• Late symptoms include coughing and shortness of breath.

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**Deer mice have white bellies and feet.** Their tails are furred and the underside is also white. House mice have scaly, non-furred tails and do not have white bellies or feet. Deer mice also have larger eyes and ears than house mice.

**Hantavirus Hotline**

877-232-3322 or 404-639-1510

**Centers for Disease Control and Prevention,**

[www.cdc.gov/hantavirus/](http://www.cdc.gov/hantavirus/)

**HPS Symptoms:**

Fever, fatigue and muscle ache of large muscle groups (thighs, hips, back and sometimes shoulders) occur in all cases.
Earaches, rashes, and sore throat are **VERY UNCOMMON** symptoms in HPS.

The Sin Nombre virus is passed in the feces, urine and saliva of infected deer mice.

The virus is spread to humans when dust particles containing rodent urine, droppings or saliva are stirred into the air and then inhaled.

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Symptoms do not appear for 1 to 3 weeks. Occasionally symptoms may take up to 6 weeks to appear. Shortness of breath is a symptom that appears later as the lungs fill with fluid, leading to frequent misdiagnoses of pneumonia. Abdominal pain and bilateral filling of the lungs in HPS help to differentiate HPS from pneumonia.

**Transmission of Hantavirus**

The Sin Nombre virus is passed in the feces, urine and saliva of infected deer mice. The major route of transmission to people is through breathing contaminated air. Being bitten by an infected deer mouse can also transmit the virus, but this type of transmission is rare. Biting along with grooming probably help perpetuate the virus within deer mice populations.

The greatest risk of transmission is from rodent infestations in or around the home. Any activity that results in contact with rodent droppings, urine, saliva or nesting materials can put you at risk. The virus is spread when dust particles containing rodent urine, droppings or saliva are stirred into the air and then inhaled. It is very important to avoid stirring up dust when dealing with rodent infestations to avoid risk of hantavirus infection.

Person-to-person transmission has not been observed and health care workers who have cared for HPS patients have not become infected. Pine nuts have been mentioned as a possible source of Sin Nombre virus. This is incorrect. While increases in pine nut harvests contribute to increases in deer mouse populations, they do not carry the HPS virus!

None of the hantaviruses identified in the United States are transmitted by any animals other than the rodents previously mentioned. Guinea pigs, hamsters, gerbils and domestic rats and mice are not known to carry hantavirus. Dogs and cats are not known to carry hantavirus, but they may bring infected rodents into contact with humans if they catch and bring rodents back to their human owners. As with all rodents, use caution when handling injured or dead rodents (see Eliminating an Infestation Safely on the next page.)

**Risk Factors**

There do not appear to be differences in susceptibility to HPS due to age or sex. An increased likelihood of exposure to deer mice increases your chance of contracting the disease. Entering tightly closed areas that are infested with deer mice increases the risk. Spring and summer are the seasons when most cases occur, due to increased contact with rodents – i.e. deer mice.
## Rodent Control Strategies

### Prevention

Rodent-proofing and sanitation are the best ways to eliminate deer mice and minimize the chances of contracting hantavirus. To keep deer mice out of a building, seal all openings over ¼-inch in size. Openings can be sealed with steel wool, cement, lath metal, hardware cloth, sheet metal or caulk. Do not seal with materials that can be easily chewed through by rodents. Entrance routes include:

- Holes around doors, windows, closet floors, cupboard floors, fireplaces, etc.
- Gaps around holes cut into walls or floors for gas pipes, vents, electrical lines, plumbing, etc.
- Gaps in rafters, gables, eaves, foundations or basement walls.
- Gaps in attic or crawl space access routes.
- Gaps in seals placed around door, garage doors and windows.
- Disintegrating caulking or rubber seals.

Remove trash, brush and debris from around the outside of structures. Use rodent-proof containers for storing food and trash, both inside and outside the home. Keep pet food in sealed containers when not being used. Do not consume food or use animal feed that you suspect may be contaminated with rodent droppings, urine or saliva.

### Eliminating an Infestation Safely

Before cleanup can begin, all rodents should be trapped. Deer mice can be trapped using snap traps (mouse traps.) Peanut butter mixed with uncooked oatmeal is an effective bait. Trapped deer mice can be buried or placed in a bag or container and then into the trash. Continue trapping for a minimum of one week. To prevent re-infestation, seal all potential entry points. To reduce the risk of contracting HPS, wear rubber gloves when handling deer mice.

If at all possible, allow the infested area to remain undisturbed for four to five days after the rodents have been removed. Research indicates that the virus does not remain viable after about three to four days. Before beginning to clean an infested area, open the windows and doors and allow the room to air out for 30 minutes. Try to establish cross-ventilation, and exit the area while it is airing out. If dusty areas must be entered, wear a respirator or dust mask with a HEPA filter to remove viruses.

Next, spray any urine, droppings and nesting materials with disinfectant or a solution of one part bleach to nine parts water. Soak urine, droppings and nesting materials with the disinfectant or bleach solution and allow them to

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remain undisturbed for five to ten minutes before wiping up the droppings or nesting materials with paper towels. Try to limit disturbance that raises dust, as this will increase the levels of airborne virus. Avoiding sweeping or vacuuming the materials, especially fresh materials.

Clothing, bedding and other fabric-based materials can be laundered in hot water and detergent and then dried in a machine dryer set on high heat. Detergent breaks down the virus’s lipid envelope, rendering it harmless. The virus is also inactivated at a temperature of about 115 degrees F. Unfortunately, not all dryers reach this temperature, even on a high or hot setting. Use both detergent and the dryer heat to inactivate the virus. Fabric materials that can’t be washed and dried in conventional machines, such as carpeting, rugs or upholstered furniture, can be disinfected with a commercial-grade steam cleaner or shampoo machine and detergent or disinfectant.

Plastic, glass or metal utensils or items can be disinfected by washing in hot water and soap or detergent. Papers, books and other items that can’t be cleaned with liquids can be sanitized by direct sunlight. Research indicates that ultraviolet light can inactivate the virus, so placing contaminated items in direct sunlight for several hours can help render the virus inactive. Use caution when handling contaminated items. Wear rubber, latex or vinyl gloves and respiratory protection when handling these items. Change clothes and wash before eating, drinking, smoking or touching your face. Wash the clothing you wore in hot water and detergent.

**Treatment**

There is no specific antidote or vaccine for HPS. Treatment consists of ventilation and early aggressive treatment of the symptoms. Medical care in an intensive care unit that provides detailed monitoring is extremely important. The earlier diagnosis and treatment begins, the better the chances of recovery. See your doctor immediately if you experience any of the symptoms mentioned, and be sure to mention that you have been around rodents.

**Conclusion**

As with all pest control, the best method is prevention. Do not allow rodents to become established in dwellings or outbuildings. Use proper sanitation to reduce the attractiveness of the site for rodents.