

## Hantavirus

### Summary

There are several different hantaviruses (family Bunyaviridae) that cause disease worldwide. The hantavirus present in New Mexico is known as Sin Nombre Virus and is one of the “New World” hantaviruses that cause hantavirus pulmonary syndrome (HPS) in humans. Hantaviruses are vectored by rodent hosts. Virus is excreted in the rodent’s saliva, urine, and feces; human exposure is usually through inhalation of aerosolized virus from dried feces and urine. The best way to prevent HPS is to avoid exposure to rodent urine and feces.

### Reservoir/Vector

The main host of Sin Nombre virus is the deer mouse, *Peromyscus maniculatus*. Other species of *Peromyscus* mice such as the white-footed mouse (*P. leucopus*) are also potential vectors. Deer mice are about the same size as the common house mouse (*Mus musculus*; see Fig. 1). They can be told apart by the white feet and distinctly contrasting white belly of the deer mouse; house mice are uniformly colored with a buffy belly. In addition, the deer mouse has fur on its tail, unlike the house mouse which has a scaly, mostly naked tail. The color of the deer mouse varies and can be grey, buff, brown, or reddish brown but the underbelly is always white and there is a clearly defined (sharply bicolored) color difference on the tail between dark fur dorsally (on the back) and white fur ventrally (on the bottom).

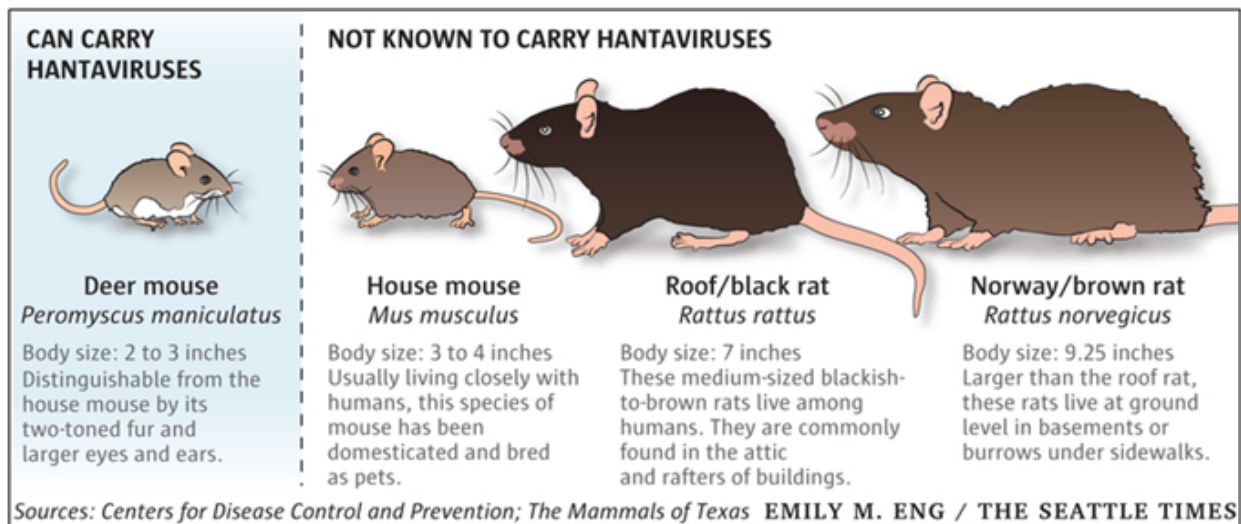


Figure 1

Deer mice are the most widely distributed and abundant non-human mammal in North America and can thrive in a variety of habitats. They are more common in rural and semi-rural areas than in urban areas. These omnivorous mice are mostly nocturnal and are active year-round.

The average caller is not experienced enough to tell the difference among deer mice, other *Peromyscus* species, and house mice, and should not be handling rodents or carcasses closely enough to tell. Further, the presence of any mouse species is evidence that the space is

accessible to deer mice; multiple species of mice may inhabit the same area. Any rodent activity or infestation in New Mexico should be treated as if it could be contaminated with hantavirus and cleaned accordingly.

Hantavirus in deer mice causes lifelong asymptomatic infection with persistent viremia and virus in the saliva. Hantavirus infection rates among hosts in New Mexico are highly variable in time and space. Infected mice look and behave identically to uninfected mice. *Any Peromyscus sp.* mouse in New Mexico should be considered potentially infectious. **Laboratory testing of mice for hantavirus is not available in the United States.**

## Exposure/Transmission/Infectious Route

Hantavirus is excreted in the urine, feces, and saliva of infected mice. A single mouse leaves up to 75 droppings and thousands of microdroplets of urine per day. Exposure to hantavirus is primarily through the inhalation of aerosolized virus when areas contaminated with rodent urine or feces are disturbed. Transmission can also occur when infectious material meets broken skin or mucous membranes, or, rarely, through the bite of an infected rodent. Rodent bites in New Mexico are usually considered low risk, because there has not been evidence of significant disease transmission by this route. The greatest risk of acquiring HPS is associated with entering or cleaning rodent-infested structures.

There is no person-to-person transmission of Sin Nombre virus.

## Activities with Potential Risk for Hantavirus Infection

- Opening or cleaning cabins, trail shelters, sheds, outbuildings, barns, garages, storage facilities, crawl spaces, recreational vehicles (i.e. RVs, campers), old vehicles or vehicles that have not been used regularly.
- Cleaning any area with signs of rodent activity (rodents, nests, droppings, etc. observed).
- Construction, utility, or pest control workers can be exposed if working in crawl spaces, under houses, or vacant buildings with rodent activity.

## Symptoms

### Incubation Period

The incubation period of hantavirus infection is uncertain. However, with the limited information available, symptoms may develop between 1 and 8 weeks after exposure with most developing between 2-3 weeks after exposure.

The patient might not recall if there was exposure to rodents and be aware that they had been exposed to aerosolized virus from rodent dried feces and urine.

Symptoms may be highly variable among patients; some patients may not report any prodromal symptoms at all or may report simply 'feeling kind of sick' for a short time before serious symptoms begin.

### Prodrome (Early Symptoms)

The prodrome, or early symptoms, of HPS include fatigue, fever, and myalgia (muscle aches), especially in the large muscle groups—thighs, hips, back, or shoulders. **Fever is not always**

**reported or detected.** Providers should not rule out HPS in afebrile patients with symptoms that are otherwise compatible.

There may also be malaise, headaches, dizziness, lightheadedness, chills, sweats, and abdominal problems such as nausea, vomiting, diarrhea, and abdominal pain. About half of all HPS patients experience these symptoms.

### Late symptoms

Late symptoms usually begin three to five days after the initial phase of illness; however, HPS patients often cannot pinpoint their exact onset date. Late symptoms include coughing, shortness of breath, and pneumonia/lungs filling with fluid. Tachypnea (rapid breathing) and tachycardia (rapid heartbeat) are typical findings upon presentation. Once this phase begins disease progresses rapidly, necessitating hospitalization and often ventilation within 24 hours.

### Fatality Rate

The fatality rate of HPS in the United States is about 38%.

Signs that make HPS unlikely in a patient include a runny nose, rashes, conjunctival or other hemorrhages, throat or conjunctival erythema, petechiae, and peripheral or periorbital edema.

### Diagnosis and Testing

Providers should review CDC's HPS Technical/Clinical Information regarding Clinical Manifestations for detailed information.

### Consulting UNM PALS

Providers who suspect HPS in a patient should quickly request an infectious disease consult or contact The University of New Mexico Health Sciences Center Physician Access Line Service, **UNM PALS, at 505-272-2000 or 888-886-7257**. Early consultation with UNM is recommended to put the extracorporeal membrane oxygenation (ECMO) team on standby to receive a HPS patient. The University of New Mexico Hospital, Presbyterian Hospital, and Lovelace Medical Center are the only facilities in the state with ECMO capability for both pediatrics and adults. Receiving ECMO support increases the chances of survival and recovery by two-thirds in HPS patients.

### Notifiable Condition Reporting

According to New Mexico Administrative Code 7.4.3.13, confirmed or suspected HPS must be reported to NMDOH's Infectious Disease Epidemiology Bureau by calling 1-833-SWNURSE (1-833-796-8773) **within 24 hours**.

### The 5 Laboratory Diagnostic Criteria for HPS

HPS should be considered when thrombocytopenia (low platelet count) occurs with severe pneumonia or pulmonary edema clinically resembling acute respiratory distress syndrome in the proper epidemiologic setting.

If hantavirus infection is suspected, a CBC and blood chemistry should be repeated every eight to 12 hours. Typical clinical laboratory findings:

- Increased hematocrit
- Left shift in the white blood cell count

- Absence of toxic changes in neutrophils
- Thrombocytopenia
- Circulating immunoblasts (basophilic cytoplasm, prominent nucleoli and increased nuclear cytoplasmic ratio)

Serological testing (IgM positive or IgM and IgG positive) is the usual way of confirming a diagnosis of hantavirus infection. Positive results from commercial laboratories must be confirmed by the Scientific Laboratory Division of the NMDOH (SLD) or the Centers for Disease Control and Prevention (CDC). Other diagnostic tests, including PCR, exist but are not routinely performed by New Mexico's Scientific Laboratory Division. False positive IgM results are common from commercial laboratories; diagnosis relies on confirmatory testing at SLD or the CDC.

Hantavirus specific immunoglobulin IgM and IgG antibodies often are present at the onset of clinical disease. IgG may be negative in rapidly fatal cases. Samples that are Hantavirus IgG positive but IgM negative will not generally be subjected to further confirmatory testing, since the lack of IgM rules out acute infection.

## Patient Management and Treatment

Patients with suspected HPS should be transferred immediately to a care facility where supportive management of pulmonary edema, severe hypoxemia, and hypotension can occur.

Consultation with an infectious disease specialist or UNM PALS, followed by contacting NMDOH at 1-833-796-8773, is strongly recommended whenever HPS is suspected.

There is no specific cure, treatment, or vaccine for hantavirus infection, however HPS patients do better when they are diagnosed early and receive supportive care in an intensive care unit. Often HPS patients are intubated and receive oxygen therapy.

Fluid management of potential HPS patients must be monitored extremely carefully due to the potential for capillary leakage, which can worsen pulmonary symptoms.

The University of New Mexico Hospital and Presbyterian Hospital are the only facilities in the state with ECMO capability for both pediatrics and adults. Receiving ECMO support increases the chances of survival and recovery by two-thirds in HPS patients with predicted mortality of 100% without ECMO (Wernly, 2011).

There is no person-to-person transmission of Sin Nombre virus. Standard precautions are recommended for health care providers.

## Surveillance Case Definitions

Surveillance case definitions are uniform criteria, created by the Council of State and Territorial Epidemiologists, used to define a disease for public health surveillance. Surveillance case definitions are not intended to be used by healthcare providers for making a clinical diagnosis or determining how to meet an individual patient's health needs.

### Hantavirus Pulmonary Syndrome (HPS) 2015 Case Definition

Hantavirus pulmonary syndrome (HPS), commonly referred to as hantavirus disease, is a febrile illness characterized by bilateral interstitial pulmonary infiltrates and respiratory compromise usually requiring supplemental oxygen and clinically resembling acute respiratory disease syndrome (ARDS). The typical prodrome consists of fever, chills, myalgia, headache, and

gastrointestinal symptoms. Typical clinical laboratory findings include hemoconcentration, left shift in the white blood cell count, lack of toxic changes, thrombocytopenia, and circulating immunoblasts (the “five diagnostic criteria”).

### Clinical Case Definition

An illness characterized by one or more of the following clinical features:

1. A febrile illness (i.e., temperature greater than 101.0° F or 38.3° C) characterized by bilateral diffuse interstitial pulmonary edema that may radiographically resemble ARDS, with respiratory compromise.
2. Respiratory compromise requiring supplemental oxygen, developing within 72 hours of hospitalization, and occurring in a previously healthy person.
3. An unexplained respiratory illness resulting in death, with an autopsy examination demonstrating noncardiogenic pulmonary edema without an identifiable cause.

### Laboratory Criteria for Diagnosis

- Detection of hantavirus-specific IgM or rising titers of hantavirus-specific IgG.
- Detection of hantavirus-specific RNA by PCR.
- Detection of hantavirus antigen by immunohistochemistry.

### Case Classification

**Confirmed:** a clinically compatible case that is laboratory confirmed.

Laboratory testing should be performed or confirmed at a reference laboratory. Because the clinical illness is nonspecific and ARDS is common, a screening case definition can be used to determine which patients to test. In general, a predisposing medical condition (e.g., chronic pulmonary disease, malignancy, trauma, burn, and surgery) is a more likely cause of ARDS than HPS, and patients who have these underlying conditions and ARDS need not be tested for hantavirus.

## Hantavirus Infection, non-hantavirus pulmonary syndrome 2015 Case Definition

### Clinical Description

Non-HPS Hantavirus infection is a febrile illness with non-specific viral symptoms including fever, chills, myalgia, headache, and gastrointestinal symptoms, but no cardio-pulmonary symptoms. Typical clinical laboratory findings include hemoconcentration, left shift in the white blood cell count, neutrophilic leukocytosis, thrombocytopenia, and circulating immunoblasts. Patients that develop cardio-pulmonary symptoms should be classified as having HPS.

### Laboratory Criteria for Diagnosis

- Detection of hantavirus-specific immunoglobulin M or rising titers of hantavirus-specific immunoglobulin G, or
- Detection of hantavirus-specific ribonucleic acid in clinical specimens, or
- Detection of hantavirus antigen by immunohistochemistry in lung biopsy or autopsy tissues

### Case Classification

## Confirmed

A clinically compatible case of Non-HPS Hantavirus Infection with laboratory evidence.

## Reporting

Report all suspected or confirmed cases of hantavirus infection in a New Mexico resident within 24 hours to the Infectious Disease Epidemiology Bureau (IDEB) at 1-833-796-8773. Information required includes: patient's name, age, sex, race, ethnicity, home address, home phone number, occupation, and health care provider.

Case Investigation within the New Mexico Department of Health's jurisdiction (all residents of the State of New Mexico, with some exceptions for those who live on tribal or federal lands) are usually completed by IDEB staff. Investigation requires completion of the CDC Hantavirus Pulmonary Syndrome Surveillance Report Form, which can be mailed to the IDEB, P.O. Box 26110, Santa Fe, New Mexico 87502-6110; or faxed to 505-827-0013. Zoonotic Disease Team staff will also complete an Environmental Assessment Form and a New Mexico-specific Case Report Form. Investigation information is entered into the New Mexico Electronic Disease Surveillance System (NM-EDSS) per established procedures.

## Case Counts and Case Data

### National

An Interactive Map, Table, and Charts of US Hantavirus Disease Cases Based on Data Collected from the Nationally Notifiable Disease Surveillance System (NNDSS). [Reported Cases of Hantavirus Disease | Hantavirus | DHCPP | CDC](#)

## Prevention

### Seal Up, Trap Up, Clean Up!

The best protection against hantavirus is to avoid exposure to rodents.

#### Seal Up!

- Seal holes and gaps in buildings. When inspecting, remember that rodents can climb stucco or textured walls, so check for holes and gaps above ground level as well.
- Clean up any food that could attract rodents, including birdseed and pet or livestock feed.
- Clean up any material that could provide shelter or nesting material for rodents. Remove cloth, textiles, paper, cardboard, upholstered furniture, pet beds and blankets, cushions, clothing, etc. from areas where rodents could have access to them. If they cannot be removed these items should be placed in rodent-proof storage.
- Rodents can chew through cardboard and some plastics: storage areas and garages should be checked routinely for signs of rodent activity.
- Stored items and wood piles should be kept on racks two feet above the ground.
- Allowing outdoor cats or other pets to hunt rodents is not an effective way to reduce exposure to hantavirus and could increase the risk of other illnesses. Supervise pets when outdoors, and do not allow pets to roam freely or hunt.
- Rodent-proof trailers, hogans, etc. (see Fig. 2).

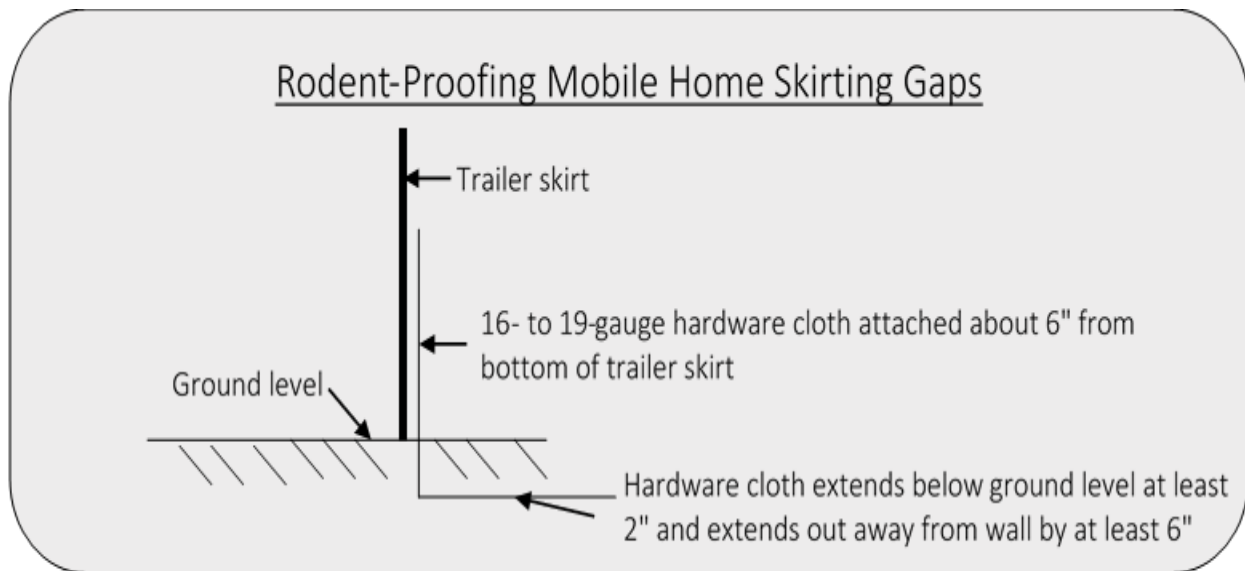


Figure 1

### Trap Up!

- Snap traps or other instantly lethal trapping methods are usually the easiest, most humane, and most economical method of rodent control inside of homes and structures. Traps should not be reused or should be sanitized if reuse is necessary.
- Poisons and rodenticides can be more costly and difficult to use than snap traps and have the potential to injure children, pets, and beneficial wildlife. Only FDA-approved products should be used, and the label must always be followed.
- Glue traps are **not** recommended. Rodents caught in glue traps are not killed instantly and may have increased urine output as part of their fear response. In addition to being less effective than other trapping methods such as snap traps, glue traps are considered by many to be inhumane and have a high risk of capturing harmless or beneficial species.
- Live trapping and relocation of rodents is **not** recommended. Live traps increase the risk of exposure to infectious material and could spread disease to new areas. Relocated rodents have poor chances of survival in unfamiliar areas.
- Whatever trapping method is used; it is important to also protect against fleas that could carry plague. Dust the area around traps and rodent nests with an insecticidal powder effective against fleas, following the label. Use DEET or another EPA-approved insect repellent when working near rodents or their nests and burrows.
- When a rodent is trapped, the carcass, trap, and any droppings or other rodent signs should be disinfected according to the Clean Up! instructions below. After disinfection the trap and rodent may be placed into double plastic bags, sealed shut, and placed into the trash; this step should be performed while wearing impermeable gloves which are then sanitized or disposed of.
- Continue trapping until no new rodents are captured for about a week. At this point the active rodent infestation has been controlled and enough time has passed that the risk of hantavirus exposure is much lower.

### Clean Up!

Once sealing and trapping have been performed, cleaning can begin.

- A bandana, surgical mask or dust mask does **NOT** offer protection against HPS. See CDC's guidance for cleaning Heavy Rodent Infestation for information about personal protective equipment, including respiratory protection (masks). [How to Clean Up After Rodents | Healthy Pets, Healthy People | CDC](#)

- Before entering a space where rodents have been, air out and cross-ventilate the area for at least 30 minutes.

- **DO NOT** stir up dust by sweeping or vacuuming droppings, urine, or nesting material.

First clean any obvious rodent droppings, urine, carcasses, or nests:

- Wear impermeable gloves (e.g. rubber, latex, vinyl). Dispose of or sanitize after use.
- Spray any potentially contaminated area with a disinfectant or a 10% bleach solution (one part bleach to nine parts water), fully saturating it, and allow to soak for at least five minutes. When using a commercial disinfectant, follow the label instructions for dilution and disinfection time. Any EPA-approved product with "disinfectant" on the label is sufficient.
- Using a disposable product (e.g. paper towels, rags), pick up the material and place into double plastic bags, seal, and put into garbage. Ensure trash is covered and not accessible to animals.
- Discard or sanitize gloves and wash hands.

Next clean and disinfect the entire area:

- Put on clean gloves.
- Mop floors (or spray dirt floors) and clean surfaces with disinfectant or 10% bleach solution.
- Steam clean or shampoo upholstered furniture, carpets, and other textiles.
- When possible, move items to a sunlit, well-ventilated area for cleaning.
- Dispose of any material, such as cardboard, that cannot be disinfected.
- Wash any potentially exposed bedding or clothing with laundry detergent in hot water and dry on high heat or in the sun.
- Contaminated insulation should be placed into plastic bags and disposed of.
- Discard or sanitize gloves and wash hands.
- Shower and discard the clothes worn during cleaning or wash in hot water with laundry detergent and dry on high heat or in the sun. Footwear can be sprayed with disinfectant if it cannot be washed.

### Cleaning Vehicles

- See CDC's specific instructions for safely cleaning rodent-infested vehicles. [How to Clean Up After Rodents | Healthy Pets, Healthy People | CDC](#)

### HVAC/Air Ducts/Ventilation Systems

- When there is evidence that rodents have access to heating and cooling ventilation systems, it is best to contact a professional rodent exterminating service to remove them. Companies specializing in duct cleaning are familiar with the problems and risks associated with rodent infestation in ventilation systems.

- For more specific information on eliminating rodent infestations in heating and cooling ventilation systems and the companies that perform this service, refer to the Environmental Protection Agency's website

See **Hantavirus Pulmonary Syndrome** Fact Sheets ([English](#)) ([Spanish](#)).

## Frequently asked questions

### **I need to clean an area with signs of rodents. How do I stay safe?**

Review hantavirus prevention and cleaning recommendations. For more details visit CDC's webpage: [How to Clean Up After Rodents | Healthy Pets, Healthy People | CDC](#)

### **Will a surgical mask/dust mask/bandana protect me from hantavirus?**

No. Most cleanup can be done safely by following the cleaning recommendations in this document or at CDC's webpage. For heavy infestations, wear 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. Follow OSHA standards regarding pulmonary function and fit testing before using a respirator.

### **I found a mouse. Can you test it for hantavirus?**

There is currently no laboratory in the United States that routinely performs this kind of testing. We already know that some mice in New Mexico are infected with hantavirus. ANY mice, droppings, urine, feces, or nests should be treated as a potential risk and appropriate precautions should be taken.

### **My patient was exposed to mouse droppings. They are currently asymptomatic/have a minor cold/have minor upper respiratory symptoms. Should they be tested for hantavirus infection?**

Asymptomatic people should NOT be tested for hantavirus infection. This greatly increases the chance of false negative or false positive results.

Hantavirus infection does not cause chronic or prolonged mild illness. A provider should evaluate the patient for other, more common causes of their symptoms.

Patients should be advised to seek care if symptoms worsen or if they experience severe illness, including shortness of breath, difficulty breathing, signs of pneumonia, etc.

### **I cleaned mouse droppings without proper PPE. I am currently asymptomatic. Can I be tested for hantavirus?**

**Asymptomatic people should NOT be tested** for hantavirus infection. This greatly increases the chance of false negative or false positive results. Seek care if you experience severe or worsening illness, including shortness of breath, difficulty breathing, signs of pneumonia, etc.

**I have a history of rodent exposure and I've had a cold/upper respiratory infection/mild illness for a few weeks since. Should I be tested for hantavirus infection?**

Hantavirus infection does not cause chronic or prolonged mild illness. You may choose to speak to a health care provider about your symptoms.

Seek care if you experience severe or worsening illness, including shortness of breath, difficulty breathing, signs of pneumonia, etc. Let your provider know about any rodent exposure.

**I was exposed to rodent droppings. How long until I know whether I caught hantavirus or not?**

The incubation period for HPS is one to eight weeks. Asymptomatic people should not be tested for hantavirus infection due to the risk of false positive or false negative results. If you develop symptoms that concern you, you should consult your health care provider.

**My household member/co-worker/relative has been diagnosed with hantavirus pulmonary syndrome. Should I be tested?**

Clusters, outbreaks, or multiple cases of HPS in a household are rare but possible. Symptomatic people should be evaluated by a provider.

Asymptomatic people should NOT be tested for hantavirus infection. This greatly increases the chance of false negative or false positive results.

Patients should be advised to seek care if symptoms worsen or if they experience severe illness, including shortness of breath, difficulty breathing, signs of pneumonia, etc.

**There are rumors that someone in my community has HPS. I need to know their address or what city they live in so I can protect my own health.**

In order to comply with medical privacy laws, the NMDOH does not release patient information below the county level. All New Mexicans should take precautions against hantavirus, whether there has been a case near them recently or not.

**Mice built a nest inside my vehicle. How do I make it safe?**

CDC provides detailed guidance on the safe cleaning of rodent-infested vehicles. [How to Clean Up After Rodents | Healthy Pets, Healthy People | CDC](#)

**Mice built a nest inside the ventilation system/air ducts of my building. How do I make it safe?**

When rodents have contaminated heating and cooling ventilation systems it is best to contact a professional rodent exterminating service to remove them and a HVAC company that specializes in duct cleaning. See more on the EPA website. [Pest Control: Resources for Housing Managers | US EPA](#)

**There is a rodent infestation on my property. Since it's a public health risk, can you come clean it for me?**

Cleaning rodent-infested properties is not provided as a government service. You may contact a private company, and I am happy to share recommendations about safe cleaning practices.

**There is a rodent infestation in the place I rent and the landlord refuses to do anything about it. What can I do?**

Epidemiologists at the New Mexico Department of Health are not qualified to provide legal advice. The answers to many tenant questions can be found in the Renter’s Guide (Spanish: Guía para Inquilinos) created by New Mexico Legal Aid. Tenants may also contact New Mexico Legal Aid at 833-LGL-HELP (833-545-4357) or visit their website at [www.newmexicolegalaid.org](http://www.newmexicolegalaid.org).

People within the city limits of Albuquerque can call 311 for information about local ordinances pertaining to this situation.

**My neighbor’s property is attracting rodents. What can I do?**

Epidemiologists at the New Mexico Department of Health do not have any code enforcement abilities. Make sure your property is safe by following prevention instructions. Contact local authorities/Code Enforcement (Albuquerque residents can call 311).

**I was bitten by a rodent. What do I do?**

Rodent bites in New Mexico are usually considered low risk. Thoroughly irrigate and clean the wound with water and soap. See a medical provider for wound care if necessary. If you develop symptoms of illness within the next eight weeks (especially sudden high fever, chills, shortness of breath, difficulty breathing, or pneumonia), tell your provider about the rodent exposure. Rabies post-exposure prophylaxis is usually not recommended for rodent bites. Testing rodents who’ve bitten people (whether for hantavirus, rabies, plague, or tularemia) is usually not recommended.

**Are there other diseases rodents can carry that I should be concerned about?**

In addition to hantavirus, rodents in New Mexico may also carry bacterial diseases such as plague or tularemia. Other rodent-borne diseases are rare or absent in New Mexico. The best way to protect against these diseases is to avoid contact with rodents, the fleas and ticks they may be carrying, and their nests, urine, and droppings. Follow the recommendations in this document and on CDC’s website for hantavirus prevention, tularemia prevention, and plague prevention.

**Is there a lot of hantavirus where I live?**

Maps showing every reported case of HPS in New Mexico can be found on the NMDOH hantavirus webpage. Everyone in New Mexico should take precautions against hantavirus, even if they are in an area with few or no human HPS cases reported.

**Can my pets or livestock catch hantavirus?**

There is no evidence that pets or livestock get sick from hantavirus. There is no evidence of hantavirus being spread to people by pets or livestock. Pets should be prevented from roaming and hunting so that they do not bring rodents they catch into the home. Pets should also be on a flea control product all year to prevent the spread of other diseases.

**I do not live in New Mexico, but I think I may have HPS.**



# COMMUNICABLE DISEASES MANUAL

## INFECTIOUS DISEASE EPIDEMIOLOGY BUREAU

If you are sick you should consult a health care provider. You may also call your local or state health department. I am happy to share hantavirus prevention information with you.