



# Conserve O Gram

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## Hantavirus Disease Health And Safety Update

Hantavirus infection, a rare but serious respiratory virus transmitted by mice and rats, was first recognized in the United States in 1993 with reported cases in the Four Corners area of Arizona, New Mexico, Colorado, and Utah. Since that time, over 600 cases have been reported throughout the U.S. Although the majority of cases occur in the western U.S., hantaviruses occur throughout the country. Therefore, all NPS units should be aware of the risk.

Procedures described in this *Conserve O Gram* apply to areas where museum collections are housed or displayed. Park museum staff responsibilities place them in situations that might pose the risk of hantavirus infection if mice or rats are present. Such situations include:

- Performing housekeeping in exhibit and storage spaces.
- Opening museum collections storage and exhibit spaces only on a periodic or seasonal schedule.
- Processing and rehousing recently received collections, in particular, field collections.
- Conducting inventories/assessments of collections in newly acquired or remotely located structures.

### *Transmission and Symptoms of the Disease*

The deer mouse (*Peromyscus maniculatus*) is the primary reservoir for the hantavirus in the U.S. The cotton rat (*Sigmodon hispidus*), rice rat (*Oryzomys palustris*) and white-footed mouse (*Peromyscus leucopus*) are additional reservoirs. Other rodents may carry strains of hantavirus but have not yet been identified. While only a small percentage of these mice and rats are infected with hantavirus, it is impossible to tell an infected from an uninfected rodent without laboratory testing. **Therefore, it is essential to treat all mice and rats, and their nests and excreta, including feces and urine, as contaminated by the virus, regardless of geographical location and age of the findings.**

Infected mice and rats can shed hantavirus in their saliva, urine, and feces. Humans are most at risk if they inhale infective saliva or excreta, such as dried airborne particles or contaminated dust. Besides inhalation, less common routes of transmission include direct inoculation into broken skin or eyes, bites, ingestion of contaminated food or water, and touching something that is contaminated by mice or rats and then touching the nose or mouth. Fleas and ticks are not known to have a role in hantavirus transmission. Cats, dogs, squirrels and chipmunks are not known to carry the virus. Humans cannot transmit the strains of hantavirus found in the U.S. to each other.

The incubation period is one to eight weeks. The disease begins with nonspecific or flu-like symptoms, including fever, fatigue, muscle aches, headaches, dizziness, coughing, shortness of breath, nausea, vomiting, diarrhea and abdominal pain. It rapidly progresses to severe respiratory distress due to fluid buildup in the lungs. **There is no vaccine or effective antiviral medication for this virus, but early supportive medical care can improve outcomes. Therefore, immediate sup-**

portive medical care is critical. Staff should immediately seek care if they develop these symptoms and have had contact with mice or rats and/or their nests or burrows or have been in an enclosed space occupied by these rodents. Staff should notify their healthcare provider of the potential exposure and concern for hantavirus. To date, about 36% of hantavirus infections have been fatal.

### *Recommended Actions*

1. Establish an Integrated Pest Management (IPM) program for the monitoring and trapping of mice and rats in spaces that house museum collections. Document and maintain a log of mice and rat occurrences and measures taken. For more information, see *Museum Handbook*, Part I, Ch. 5, Biological Infestations.
2. Work with the park safety officer to inform staff about the disease and precautions for reducing the risk of infection.
3. Inspect all facilities and spaces housing museum collections for evidence of mice and rats.
4. Work with staff with IPM responsibilities and maintenance staff to exclude mice and rats from structures and spaces housing collections using exclusion techniques noted below.
5. Implement a museum housekeeping program in spaces housing museum collections and in exterior adjacent areas to eliminate harborage situations conducive to the nesting of mice and rats. Systematically look for carcasses and excreta on a regular basis.
6. Take precautions (see below) when removing dead mice and rats, their excreta and nests, and traps to reduce the risk of hantavirus infection.

### *Exclusion Techniques*

The most effective method for preventing hantavirus is to exclude mice and rats from all structures that house collections. Certain techniques described below may not be appropriate in or around historic structures. Work with a historic architect, and park cultural landscape and facilities management staff to find appropriate alternatives.

1. Systematically and regularly inspect the structure's exterior and interior spaces for potential openings.
2. Seal:
  - holes in the exterior of the structure 1/4" or larger to exclude mice and rats, as rodents can fit through very small (1/4" for mice and 1/2" for rats) openings
  - windows using gaskets and/or weather stripping
  - caulk all gaps and holes, particularly spaces around windows and doors. Larger holes may require a filler such as wire mesh or spray foam insulation prior to caulking.
  - pipe, electrical conduit and HVAC duct passage penetration holes
3. Install 20 mesh screening on:
  - window exteriors
  - air vents, hot air registers, and floor drains
4. Install self-closing devices, sweeps and gaskets on all exterior and interior doors in areas housing collections.
5. Install rodent-proof chimney guards over fireplace chimneys.
6. Repair cracks and openings in stone and cement foundations with concrete or mortar.
7. Create an 18 – 30" wide vegetation free zone or 'hot zone' around the perimeter of the

structure, preferably full of four inch deep gravel where possible.

See *Museum Handbook*, Part I, Ch. 5, Section G, Control Actions and the Centers for Disease Control and Prevention (CDC) “Got Mice? Seal, Trap, and Clean Up to Control Rodents” for more information.

### ***Precautions to Reduce Risk during Cleanup***

Ensure safety during cleanup with good ventilation, appropriate use of disinfectants and good hand hygiene. When removing carcasses in traps and cleaning spaces that have mice and rat infestations wear personal protective equipment (PPE) and exercise the following precautions.

1. Before cleaning closed storage areas, areas not regularly occupied and other structures that have mice or rat infestations, ventilate the structure by opening doors and windows for at least 30 minutes. Cross ventilate if possible. Leave the area during the airing-out period.
2. Always wear nitrile or vinyl gloves when handling mice and rat carcasses, traps containing mice or rats, nests and/or nesting materials, or when cleaning infested areas, regardless of infestation levels. Wash gloves in Environmental Protection Agency (EPA) approved disinfectant before removing them from your hands. Wash your hands thoroughly after removing gloves. Do not reuse disposable gloves. Disinfect non-disposable gloves after use.
3. Wear work clothes that can be removed and disposed of or laundered after cleanup, such as washable work pants, shirt and/or coveralls that can be washed in hot water with detergent.
4. Staff involved in the cleanup of a heavy infestation should wear coveralls (disposable if possible), rubber boots or disposable shoe covers, vinyl or nitrile gloves, protective goggles, and an appropriate respiratory protection device as detailed below. A rodent infestation is considered heavy if piles of feces or numerous nests or dead rodents are observed.
5. Wearing respirators:
  - Staff should wear either a NIOSH-approved half-face, tight-seal (respirator relies on a seal with the skin surface), negative-pressure respirator or a positive pressure powered air-purifying respirator (PAPR), equipped with N-100 or P-100 filters when handling dead rodents or cleaning heavily infested areas, regardless of ventilation. Alternatively, wear a disposable N-100 respirator, use only once and dispose of after use.
  - Individuals wearing a tight seal respirator must be clean shaven. Staff with facial hair must use a loose-fitting PAPR with a hood with a blower that moves air across the breathing zone and does not rely on a seal.
  - Use the filter only once and dispose of after use. Do not touch the filter without gloves.

Employees must be in compliance with NPS Occupational Safety and Health Program, *Director's Order #50B* and *Reference Manual #50B* for respiratory protection. Requirements include medical clearance, annual training, and fit testing for each approved respirator type. Consult with the park safety officer to ensure that the respirator meets the safety requirements. For additional information see *COG 2/13, An Introduction to Respirator Use in Collections Management*.

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## *Cleanup of Surrounding Area*

Remove mice or rats and signs of mice and rats, and follow the steps noted below to clean contaminated areas surrounding objects, such as floors, cabinets or shelves. **Do not use these methods or disinfectants on museum objects as they can damage objects.** See section “Cleanup of Potentially Contaminated Museum Objects” below for procedures on how to clean potentially contaminated objects.

1. Spray dead mice and rats, their excreta, nests and traps with an EPA registered disinfectant such as Lysol® disinfectant or a 10% solution of bleach and water (see #3, *Caution* below). The bleach solution must be made fresh with each application to remain effective. Soak the contaminated material thoroughly. Wait 10 - 20 minutes. Wearing gloves, place the material in a plastic bag using an inverted plastic bag around gloved hand, enclose the material and seal the plastic bag. Use a trash grabber rod if the carcass or nesting material is in an inaccessible location. Place all used materials in the same bag. Place the bag and disposable gloves in a second plastic bag, seal and dispose of in the trash. Do not reuse traps.
2. **Do not vacuum or sweep dry surfaces before mopping or shampooing to avoid airborne infectious excreta.** A HEPA vacuum can be used to clean the area after wet cleaning/disinfection and deactivation of the virus as long as the filter is freshly installed and working properly. Dispose of the HEPA filter once the clean-up is complete.
3. Mop floor/other surfaces with Lysol® disinfectant or a 10% solution of bleach and water. A second mopping is optional. Spray dirt floors with a disinfectant solution. Disinfect rugs with a household disinfectant or commercial-grade steam cleaning or sham-

pooing. *Caution:* Some disinfectants, including household bleach, will damage rugs and other fabrics and discolor wood floors.

4. Disinfect work surfaces by washing with Lysol® disinfectant or a 10% solution of bleach and water. Alternatively, wipe down surfaces with a general-purpose household disinfectant.

## *Cleanup of Potentially Contaminated Museum Objects*

Do not use the method or disinfectants described above to clean museum objects. **Do not apply the bleach liquid spray or solution directly to museum objects as it is damaging.** Take the steps below to clean contaminated or potentially contaminated museum objects.

1. Follow PPE recommendations above. Wear gloves when handling potentially contaminated objects. Depending on the extent of the infestation, respiratory protection as noted above may be necessary.
2. Immediately double bag the object in polyethylene plastic. Seal large objects in plastic sheeting.
3. Isolate the bagged object from the collection in a rodent-free isolation area or container. At this time, the CDC Viral Special Pathogens Branch recommends an **isolation period of a minimum of three weeks. However, a longer period of six weeks is strongly suggested.** The virus is typically viable for 24 - 48 hours and is susceptible to desiccation on surfaces. However, in some conditions it can survive several days longer. Periodically inspect the isolation area or container to verify it is rodent-free for the entire isolation period.
4. Keep the object isolated at room temperature. Do not freeze the object or house at

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a lower temperature, as freezing and lower temperatures will extend the viability of the virus.

5. If the object is wet or damp from mice and rat urine, virus viability is extended. To render the virus inactive, the object must dry out. To dry the object, follow the steps above and place a desiccant such as silicone dioxide within the bag but not touching the object. Once the object is dry, isolate it for a minimum of three weeks to ensure the virus is deactivated. See *COG 1/8, Using Silica Gel in Microenvironments* for more information.
6. As applying bleach directly will damage a museum object, the CDC has indicated that isolation is sufficient treatment to deactivate the hantavirus and that normal cleaning can follow the isolation period.
7. Consult the regional curator, a conservator, and the park safety officer before considering further treatments or cleaning.

### ***Monitoring and Trapping***

1. Create a comprehensive monitoring and trapping system. Indicate and number trap placement on a schematic floor plan. Number and date each trap. Make sure the number and date will not be obscured by the catch/carcass.
2. Set and bait the appropriate quantity of spring-loaded rodent snap traps in each space. Bait the traps with peanut butter or cotton. Be aware that peanut butter can attract pests.
3. Locate traps every six to ten feet along the walls. Put traps behind (but not touching) objects, under furniture, against walls, or in other locations where mice and rats find concealment. Place two traps at each trap station parallel with the wall, or place a single trap

perpendicularly with its trigger end against the wall (Figure 1). Place a Mylar® rectangle beneath each trap, cut one inch wider than the trap, to prevent the spread or absorption of any liquids from the trapped mouse or rat, especially when trapping on a porous wooden floor.

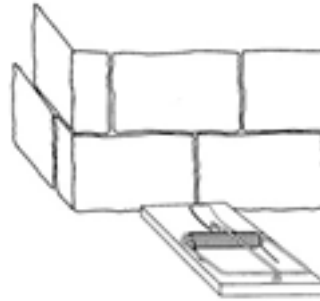


Figure 1: Trap set perpendicular to the wall

4. Inspect each trap daily. If a dead mouse or rat is discovered in a trap, follow procedures and precautions described above. If a live mouse or rat is found in a snap trap, contact IPM staff to dispose of the live rodents.
5. Create a Hanta Kit to aid in removal of trapped mice and rats that includes:
  - Plastic bags, small and large, with ties
  - Disposable gloves. See *COG 1/12, How to Select Gloves: An Overview for Collections Staff*
  - Labeled hand spraying bottle with spray attachment
  - Bleach or household disinfectant concentrate. Retain Materials Safety Data Sheets (MSDS) on file
  - Paper towels
  - New (unused) spring-loaded snap traps (ten traps per room minimum)
  - Trash grabber rod
  - Clipboard with forms to document trap catches
  - Large bucket (labeled Hanta Kit) for above contents
6. Pick up traps and/or mice and rat carcasses



using an inverted plastic bag around gloved hand. Spray the trap and/or mice or rat with bleach solution before picking up. (See above Cleanup of Surrounding Area, #1, for procedures.)

7. Maintain a record of all trapped mice and rats; include the date and location of the catches, and type and number of rodents. Document all staff involved in the cleanup and rodent-proofing and exclusion repairs. Record data in a paper log or database. See *Museum Handbook* Part I, Ch. 5, Section E Inspection and Monitoring for more information.

### Notes

Cleaning procedures and safety precautions described in this *COG* are based on the NPS Natural Resources rodent guidance documents, NPS Zoonotic and Environmentally Transmitted Diseases Steering Committee's Hantavirus Worker Protection document and the CDC's hantavirus website. Object treatment options were developed in consultation with the CDC Viral Special Pathogens Branch and the Department of the Interior public health officer (2013).

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### Sources

Nitrile gloves, silica gel packets: Gaylord Bros. <[www.gaylord.com](http://www.gaylord.com)> or University Products <[www.university-products.com](http://www.university-products.com)>

Spring-loaded snap traps, trash grabber rods available through multiple suppliers

### References

Centers for Disease Control. Hantavirus. <[www.cdc.gov/hantavirus/](http://www.cdc.gov/hantavirus/)>

National Park Service. Natural Resources, Rodent Management (guidance documents and manuals, hantavirus information and webinars). <[www1.nrintra.nps.gov/brmd/ipm/rodent.cfm](http://www1.nrintra.nps.gov/brmd/ipm/rodent.cfm)>

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