

EMERGING INFECTIOUS DISEASES®



Recurrent Occupational Hantavirus Infections Linked to Feeder Rodent Breeding Farm, Taiwan, 2022

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Introduction

- Each year in Taiwan, hantaviruses cause 0-4 human cases of HFRS.
- *Rattus norvegicus* rats are a notable local reservoir host for SEOV.
- Human infection occurs after inhalation of aerosolized excreta or secretions of infected rodents or direct rodent contact.
- Rodent-to-rodent transmission occurs through biting or scratching or by exposure from contaminated materials.



Rattus norvegicus

Introduction

- Since 2013, human hantavirus infections transmitted by pet rats have been reported in countries in Europe and USA.
- In the Netherlands, (RT-PCR) revealed 12.2% positivity among feeder rats not linked to human SEOV cases.
- Feeder rodent industry involves cultivating and selling live and frozen rats.



Frozen rats



The study

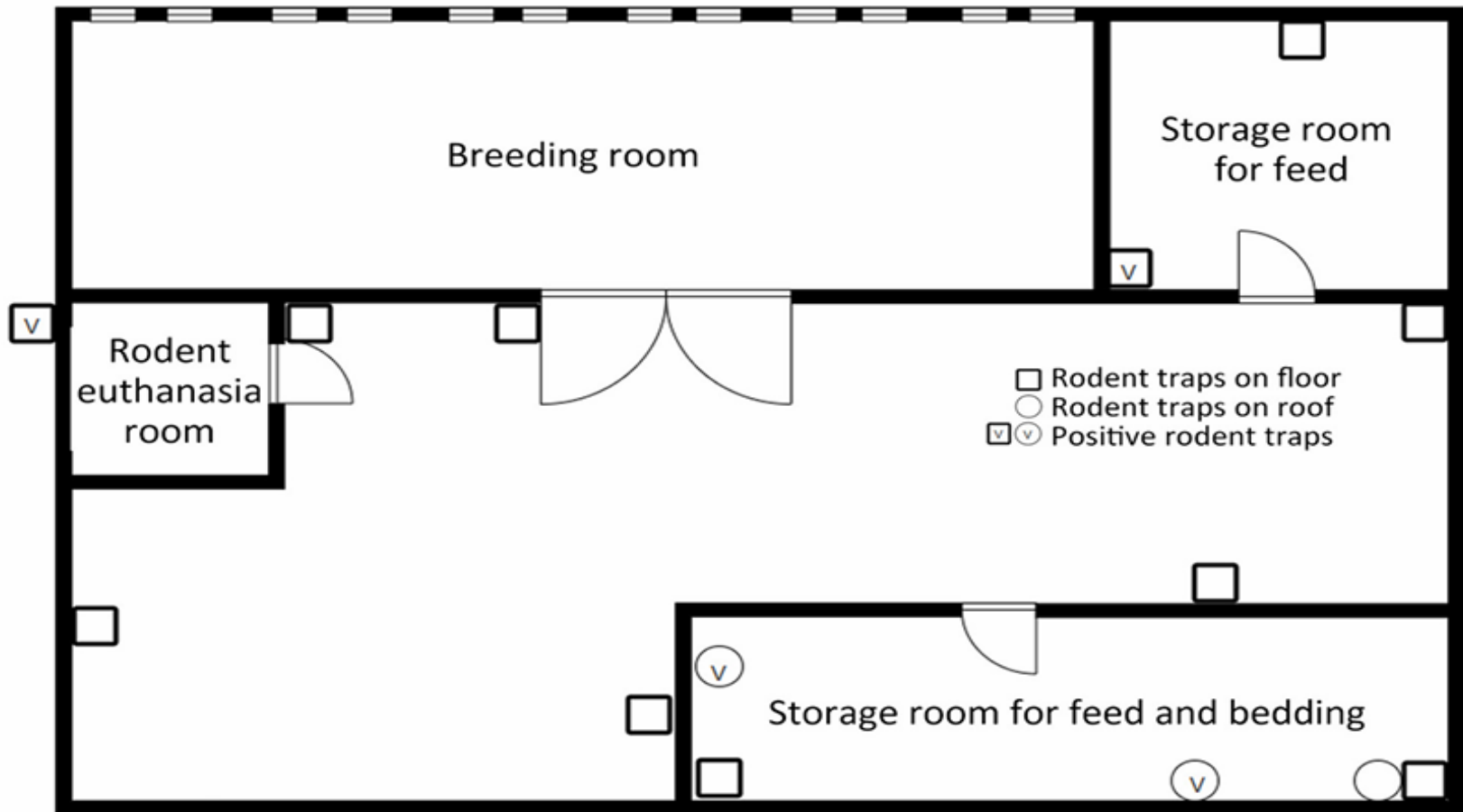
- In October 2022, hantavirus infection in a man in his 30s (case-patient A) was reported to the TCDC; Taipei, Taiwan.
- Diagnosis was confirmed by a 4-fold increase in serum IgG.
- The following symptoms were observed in case-patient A:
 - Fever
 - Generalized malaise
 - Coagulopathy
 - Acute renal failure
- He worked at a feeder rodent breeding farm.



The study

- The farm employed **5 workers** (including case-patient A) and had an approximate of **12,000 feeder mice** (*Mus musculus*) and **2,200 feeder rats** (*R. norvegicus*).
- The owner had introduced no new rodents since 2017.
- The breeding room in the farm building was an enclosed space.
- Feeder mice and rats were housed in different racks.
- Workers were required to wear face masks and gloves when working, but no protocol existed for hand hygiene.

Farm building layout



Feeder mice and rats were humanely killed with CO₂ and then vacuum-packed and stored in a freezer to be sold on the internet.

Farm building layout



Figure 2. Racks (A) and tubs (B) used at a rodent breeding farm linked to study of recurrent occupational hantavirus infections, Taiwan.

All feeder mice and rats were housed in the same room but in different breeding racks.

Rack of rats: 100-140 rats (20 tubs)

Rack of mice: 294-420 mice (42 tubs)

Trapping rodents (November 5-9, 2022)

- Fourteen traps around the farm were placed to capture wild rats.
- The owner agreed to human killing of all feeder rats on the farm (November 19).
- The mice colony was not eradicated.
- Unused bedding and feed were kept.
- The rat colony was not replenished until February 2023.

Table. Results of diagnostic testing of rodents for Seoul virus, by date trapped, in study of recurrent occupational hantavirus infections linked to feeder rodent breeding farm, Taiwan*

Species	No. IgG-positive/no. tested (%)	
	2022 Nov 5–9	2023 Feb 11–13
Feeder rodents		
<i>Mus musculus</i>	0/40 (0)	NA
<i>Rattus norvegicus</i>	3/8 (37.5)	NA
Wild rodents		
<i>Rattus tanezumi</i>	0/5 (0)	NA
<i>Rattus norvegicus</i>	NA	1/3 (33.3)
<i>Suncus murinus</i>	NA	0/5 (0)

*NA, not applicable.

Safety measures

- The other 4 workers on the farm reported no hantavirus symptoms during interviews.
- Blood samples were collected and tested.
- Previous infection was indicated in 1 worker (IgM); results for other workers were negative.
- Rodenticide and traps started being used on November 9 as wild rodent control.
- **The following sanitary measures were implemented:**
 - Rat tubs were washed, disinfected, and stored.
 - Cracks in storage rooms were sealed.
 - Bleach was used to clean used rodent tubs (5,000 ppm) and the racks and floor (1,000 ppm).



Case-patient B

- On January 15, 2023, fever and retro-orbital pain developed in another worker (case-patient B) that had tested negative in November 2022.
- Blood tests revealed thrombocytopenia and elevated liver enzyme levels.
- Positive igM titer and a 4-fold rise in IgG titer.
- RT-PCR showed hantavirus RNA in her blood.
- Genomic sequencing data submitted to GenBank matched with the SEOV nucleoprotein gene.

Trapping rodents (February, 2023)

- When the second investigation began, the farm had **12,000 feeder mice** and **no feeder rats**.
- They placed 91 traps around the farm and neighbourhood to catch wild rats, **1 out of 8 captured tested positive** for hantavirus IgG.
- Importance of hand hygiene measures and using personal protection equipment (PPE) was discussed with the farm owner.

Table. Results of diagnostic testing of rodents for Seoul virus, by date trapped, in study of recurrent occupational hantavirus infections linked to feeder rodent breeding farm, Taiwan*

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Conclusions

- Recurrent hantavirus infections on 2 workers on a feeder rodent breeding farm were identified.
- Rodents can transmit the virus horizontally through infected bedding.
- The breeder room is enclosed, and no signs of wild rat activity were found.
- It's suspected that the virus was introduced to the breeder colony by infected bedding or feed and then spread through biting and scratching.

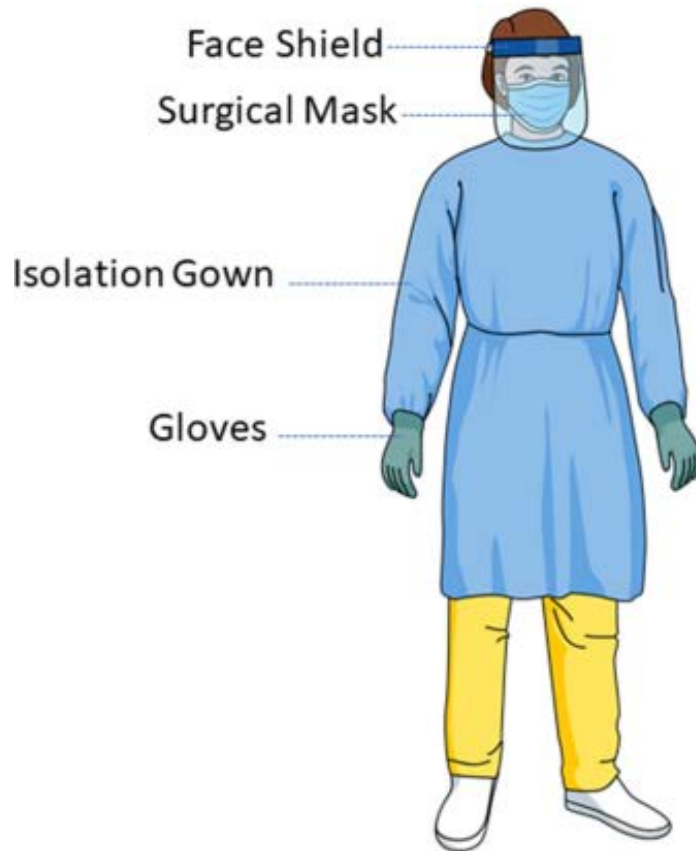


Conclusions

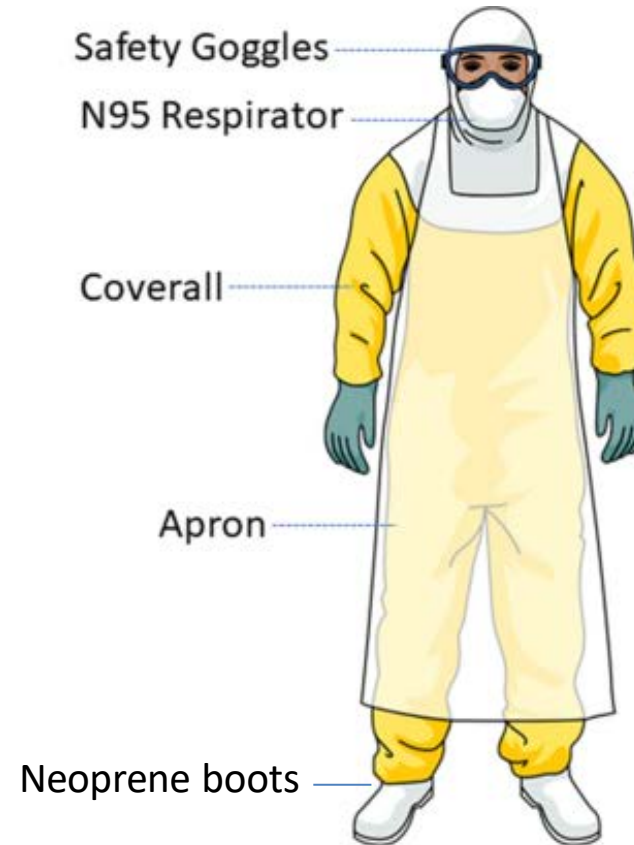
- The duration between last exposure and onset of symptoms in case-patient B was 8 weeks.
- It's possible that case-patient B was infected before the feeder rats were killed, but not diagnosed due to the long incubation period.
- Hantavirus infection has been associated with occupational exposure.
- The US Office of Animal Care and Use of National Institutes of Health state that rodent facilities should classify their activities (low, moderate, or high risk).
- Wearing appropriate PPE depending on risk level is crucial.

Conclusions

Acceptable



Preferred





Conclusions

- Rodent breeding farms should regularly monitor colony animals for hantavirus infection.
- Disinfection with bleach or other commercial disinfectants has to be done regularly.
- HFRS can manifest in various nonspecific ways.
- Knowledge of potential animal or environmental exposure is crucial for identifying hantavirus disease in workers.



Limitations

- Feeder rat organ tissues for hantavirus with RT-PCR was not tested, so it was not possible to compare viral sequences from case-patients and rats.
- Environmental samples like bedding or feed were not tested, therefore, no direct evidence of virus origin was found.
- Feeder rodents after case-patient B was diagnosed were not tested.

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