



Public Health
England

Hantavirus infection in people with contact with wild and pet rats in England – preliminary results of a sero-surveillance study

About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through advocacy, partnerships, world-class science, knowledge and intelligence, and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

Public Health England
Wellington House
133-155 Waterloo Road
London SE1 8UG
Tel: 020 7654 8000
www.gov.uk/phe
Twitter: @PHE_uk
Facebook: www.facebook.com/PublicHealthEngland

Prepared by: Jackie Duggan, Rebecca Close, Lucy McCann, Noel McCarthy, Trish Mannes, Amanda Walsh, Martin Keys, Deborah Wright, Andre Charlet, Tim Brooks
For queries relating to this document, please contact: Dr Jackie Duggan

© Crown copyright 2014

You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence v2.0. To view this licence, visit OGL or email psi@nationalarchives.gsi.gov.uk. Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned. Any enquiries regarding this publication should be sent to Jackie.duggan@phe.gov.uk.

Published: September 2014
PHE publications gateway number: 2014321



Contents

About Public Health England	2
Executive summary	4
Background	5
Infections in Humans in the UK	5
Seroprevalence Study	6
Infection in Animals	8
Conclusions	8
Interim Public Health Advice	8
Further Studies	9
References	10

Executive summary

1. Six recent cases of acute kidney injury (AKI) caused by hantaviruses have been recorded in the UK. All cases had documented exposure to pet or wild rats.
2. A sero-surveillance study was conducted in England in groups with exposure to pet and wild rats to determine the risk of hantavirus infection in these groups.
3. 32.9% of specialist pet fancy rat owners recruited to the study tested positive for hantavirus antibodies, showing previous exposure to hantavirus.
4. The occupationally exposed groups (veterinary workers, farmers, pest control workers and sewage workers) had the same level of exposure as the general population and are not thought to be at any greater risk of hantavirus infection.
5. Urine samples collected from pet fancy rats are still undergoing testing for hantavirus.
6. Interim public health advice for all groups is given in this document.
7. Further studies include testing 'casual' pet rat owners, who have purchased their pets through pet shops and other commercial sources.

Background

Hantaviruses are a group of viruses present in many countries worldwide. Different species of rodents and insectivores carry specific hantaviruses, therefore, the geographic distribution of each hantavirus can be worldwide, or located in one region, such as Europe, Asia or North and South America. Animals rarely show signs of disease; they are thought to become infected early in life and may shed virus in their excreta (urine, faeces and saliva) over prolonged periods.

Humans usually become infected with hantaviruses through the inhalation of aerosolized rodent excreta. Although some hantaviruses are associated with asymptomatic infections or mild disease, most can cause serious human infections, ranging from haemorrhagic fever and kidney failure (known as ‘haemorrhagic fever with renal syndrome’ or ‘nephropathia epidemica’) in Europe and Asia, to a severe lung disease (known as ‘hantavirus pulmonary syndrome’) in North and South America. Case fatality rates can vary from 0.1% to in excess of 50%.

Symptomatic human infections with hantaviruses in the UK are rare and, until the recognition of a case of acute kidney injury (AKI) associated with exposure to wild rats in the Humber region in 2012, were not thought to cause serious disease.¹

Infections in humans in the UK

Since 2012, there have been six cases of AKI due to hantavirus infection in the UK, which have been confirmed by laboratory diagnosis at the PHE Rare and Imported Pathogens Laboratory. Two serologically positive cases were from the Humber region and had documented exposure to wild rats. Wild rodents were trapped from the farm belonging to the second case and a strain of hantavirus was isolated from them. This strain was named Humber virus after the location of its isolation.² The strain is genetically related to Seoul virus, which is present in rats in Asia and Europe, and causes mild disease in humans.

The other four cases of AKI due to hantavirus infection have been in people with exposure to specially-bred pet fancy rats. The first detected case of hantavirus infection from exposure to pet fancy rats occurred in November 2012 in Wrexham in a man exposed to two pet fancy rats owned by his partner. His partner’s sister was a specialist breeder of fancy rats and was a member of the National Fancy Rat Society (NFRS). Epidemiological investigations determined that the two people who owned the breeding colony were both antibody-positive (ie had serological evidence of previous infection), with one person reporting being hospitalised in 2011 with AKI of unknown origin.³ The rats in the breeding colony were culled and tested and a second highly similar Seoul-like virus, named Cherwell virus, was detected from nine rats.⁴ A number of rat owners belonging to the NFRS voluntarily came forward for serological testing, and 50% of this group were found to be antibody-positive for Seoul-like hantavirus. Two more cases of AKI in rat owners have been identified subsequently, one in 2013 and one in 2014.

Molecular evidence for the Cherwell virus was demonstrated for the former patient with partial sequence of the virus recoverable from a blood sample with 100% homology to the virus isolated from the pet rat strain, thus confirming Seoul hantavirus as the causative agent of the patients AKI.

Seroprevalence study

From October 2013 to June 2014, Public Health England, led by the Rare and Imported Pathogens Laboratory, have conducted a sero-surveillance study in people with exposure to wild and pet rats to determine the prevalence of this infection in three identified at-risk groups and a control group across England. The four study groups defined for the study are described below:

- study group 1: Control random donor blood samples purchased from the National Blood Transfusion Service (anonymised)
- study group 2: Pet rat owners (either specialist rat owners contacted through the NFRS or “casual” pet rat owners who acquired their pet rats from other sources, such as pet shops)
- study group 3: People with occupational exposure to pet rats (veterinary workers)
- study group 4: People with occupational exposure to wild rats (eg farmers, pest control workers, sewage workers)

Volunteers were recruited based on the above criteria and were asked to provide a blood sample for testing and to complete a questionnaire. In total, 545 test samples were collected (84 study group 2 samples, 170 study group 3 samples, 291 study group 4 samples (120 farmers, 102 pest control workers, 69 sewage workers)). The test samples and 300 negative control samples (study group 1) were tested using a hantavirus-specific immunofluorescence assay (containing the six most common hantaviruses), which is the standard, validated test used for all hantavirus diagnosis in RIPL.

The table on the next page shows the total number of positive sera in each group. This is the number of individual sera that reacted against one or more of the six hantaviruses in the assay.

Table 1: Total number of hantavirus positive sera in each study group

Study group	Number of samples taken	Total Number of positive samples	Seroprevalence (%)
Group 1	300	10	3.33
Group 2 (Pet rat owners)	79	26	32.9
Group 3 (Veterinary)	170	3	1.76
Group 4 (Farmers)	120	2	1.67
Group 4 (Waste water workers)	70	2	2.83
Group 4 (Pest control workers)	106	3	2.83

The sero-prevalence of hantavirus infection in study group 2 was 32.9%. This means that 32.9% of all samples tested from study group 2 contained hantavirus antibodies, showing previous hantavirus exposure or infection. All positive sera showed broad reactivity across the hantavirus group, but the strongest reactions were obtained against Seoul virus, meaning that it is likely that all those with positive antibody responses were exposed to Seoul virus. All sera from this group displayed the same antibody reactivity pattern, suggesting that the same virus was involved. Three positive sera with reactivity to other hantaviruses were seen. One pest control worker and a sample from study group 1 tested positive for Dobrava antibodies, with a sero-prevalence of 0.33% and 0.94% within those groups, respectively, while one farmer tested positive for Puumala antibodies (sero-prevalence=0.83%).

Seventeen samples gave a weak positive reaction to Hantaan virus. The samples came from all four study groups with the highest number from study group 1. The rodent vector for Hantaan virus, which is normally associated with severe haemorrhagic fever in Asia, is not present in the UK. One possible explanation for this result is environmental exposure to an as yet unidentified hantavirus, or related virus, although until such a virus is available for testing, this cannot be confirmed.

Infection in Animals

A survey of hantavirus carriage in pet rats is currently being undertaken. Volunteers recruited from study group 2 were asked to collect urine samples from their rats and to send them for testing. In total, 450 rat urine collection kits were handed out to rat owners and 80 urine samples were subsequently returned. The samples are being tested at AHVLA and results are currently pending. The results of this study will be published separately.

Conclusions

In conclusion, study groups 1, 3 and 4 have a sero-prevalence rate of 1-3% for exposure to hantavirus, meaning that between 1 and 3% of those sampled had positive antibodies to hantaviruses. The sero-prevalence of study groups 3 and 4 were equivalent to the random control group 1, showing that the risk of exposure to hantaviruses in the occupationally exposed groups is no higher than the general population.

For pet rat owners, the sero-prevalence rate was 32.9%, meaning that a third of those tested had positive antibodies to hantaviruses, showing exposure to the virus. All positive sera were from specialist fancy rat owners. As yet, we do not know what the prevalence of the virus is in the rats through testing the urine samples sent back to RIPL. However, the high percentage of antibody positive owners suggests that the virus is widely present in this group of pet rats. We were not able to measure the risk of hantavirus infection to more generalised pet rat owners (ie those who purchased their rats from commercial vendors, such as pet shops) or to those who work closely with pet rats during the time of the study and so the risk of hantavirus infection in these groups remains uncertain at the present time.

Interim Public Health Advice

The results of the study show that, for occupationally-exposed groups (veterinary workers, pest control workers, sewage workers and farmers), the risk of hantavirus infection is very low. This means that no other protective measures, other than good hygiene practice, such as hand washing, is required. For occupational groups at risk of other rodent-borne diseases such as leptospirosis, no additional protective measures are required to protect against hantavirus infection.

The risk of infection for specialist pet rat owners is much higher than other exposed groups. We would, therefore, recommend to specialist pet rat owners that they take extra precautions when handling their rats to protect themselves and their household contacts, particularly children and those with chronic illnesses such as diabetes. The extra precautions we suggest are:

- House pet rats away from the main living areas of the house (living rooms, occupied bedrooms etc)
- Always wash your hands after handling your pet rats
- Wear gloves and other protective clothing, such as aprons, for activities involving contact with rat excreta, such as cleaning out cages, and expose of waste bedding in an outside bin (preferably separate to a household waste bin). Change out of protective clothing and wash hands immediately after these activities.

Pet rat owners need to be aware of the symptoms of hantavirus infection, which include flu-like symptoms such as fever and high temperature, lethargy, muscle aches, headache. If visiting your GP with these symptoms, you should mention your exposure to pet rats and the possibility of hantavirus infection. If your symptoms become severe and/or you develop symptoms such as lower back pain, or difficulty passing urine, seek immediate medical help.

Whilst these precautionary measures apply to specialist pet rat owners, we do not yet know the risks for more general pet rat owners (ie those owners who purchase their pets from commercial vendors such as pet shops) and to those who work closely with pet rats. The risk of infection with hantavirus may be very similar or may be more in line with the risk of exposure in the occupationally exposed groups. However, the hygiene precautions recommended above would help to minimise exposure to the virus.

Further Studies

Currently, we do not know whether the apparent circulation of hantaviruses in pet rats (based on the antibody results from their owners) is due to the prevalence of the virus within the specialist fancy rat group, where the rats often come into contact with each other at rat shows/meets and through breeding, or whether the virus is more ubiquitous within the overall pet rat community in the UK. It is known that the virus is present in wild rats in the UK, although the results of testing occupationally exposed workers suggest that this is not a common occurrence. The project team is currently working to engage with groups who work with pet rats, such as commercial rat breeders, and those who buy/obtain their rats from commercial vendors such as pet shops. This is so that the risk of hantavirus infection in people exposed to this group of animals can be determined.

Acknowledgements

The study team would like to thank the following for their help and support with this study. Lisa Jameson for her help with the design of the questionnaire and study documents; Tony Fooks, Lorraine McElhinney and Charlotte Featherstone for their involvement in the design of the rat urine collection kits and testing of rat urine for hantaviruses; Ann Storey, Kate Rattray and Lisa Maurin of the National Fancy Rat Society for their help in engaging with rat owners and to arrange sampling sessions at NFRS meetings and shows; everyone who helped out at events to recruit volunteers and the following organisations for allowing us access to their premises and conferences to recruit volunteers: British Small Animal Veterinary Association, National Pest Technicians Association and PestTech, Sedgemoor Livestock Market, Ross-on-Wye Livestock Market, York Livestock Market, Ashford Livestock Market, Yorkshire Water, United Utilities, Severn Trent Water.

References

1. Public Health England, Department for Environment, Food and Rural Affairs. Zoonoses report UK 2012 (September 2013).
2. Jameson LJ, Logue CH, Atkinson B, Baker N, Galbraith SE, Carroll MW, et al. The continued emergence of hantaviruses: isolation of a Seoul virus implicated in human disease, United Kingdom, October 2012. *Euro Surveill.* 2013; 18: 4-7.
3. Taori SK, Jameson LJ, Campbell A, Drew PJ, McCarthy ND, Hart J, et al. UK hantavirus, renal failure, and pet rats. *Lancet* 2013; 381: 1070. Epub 2013 Mar 22.
4. Jameson LJ, Taori SK, Atkinson B, Levick P, Featherstone CA, van der Burgt G, et al. Pet rats as a source of hantavirus in England and Wales, 2013. *Euro Surveill* 2013; 18.
5. Jameson LJ, Newton A, Coole L, Newman EN, Carroll MW, Beeching NJ, et al. Prevalence of antibodies against hantaviruses in serum and saliva of adults living or working on farms in Yorkshire, United Kingdom. *Viruses* 2014; 6: 524-534.