Hendra virus and Australian wildlife

Fact Sheet

April 2024

Key points

- Hendra virus (HeV), first identified in 1994, causes highly fatal disease in humans and horses.
- Australian flying-foxes (*Pteropus* spp.) are the natural reservoir host of HeV and do not show signs of illness when infected with HeV.
- Hendra virus has been detected in flying-foxes in NSW, Qld, Vic, SA and WA, and equine and human cases of HeV have occurred in Qld and NSW.
- Human infection occurs through contact with infected horses. Direct transmission from bats to humans has **not** been demonstrated.
- Horses can be infected by contact with excretions from flying-foxes or other horses infected with HeV.
- An equine vaccine for HeV is available; there is no human vaccine for HeV.
- HeV is a **notifiable animal disease** nationally, and in humans in most states and territories; you must notify health authorities if you suspect a horse or human has HeV (see *Surveillance and management*, below).

Aetiology

HeV is an RNA virus belonging to the family *Paramyxoviridae*, genus *Henipavirus*. Two variants are currently recognised, HeV genotype 1 (HeV-g1) and genotype 2 (HeV-g2) [1].

One Health implications

Wildlife and the environment: flying-foxes do not show signs of illness when infected with HeV. There is no evidence of transmission to other wildlife species. Hendra virus infection in flying-foxes and spillover to horses is driven in part by human-induced habitat-loss and changing climate [2, 3]. Flying-foxes play important ecological roles, but conflict and persecution can arise when people perceive these animals as a disease threat.

Domestic animals: HeV infection is highly fatal in domestic horses. Natural infection of two healthy dogs on HeV-infected horse properties has also occurred [4].

Humans: HeV infection causes serious neurological disease in humans and has a high fatality rate. All known human cases have resulted from direct contact with infected horses. A serosurvey of 128 wildlife carers who handled bats (and therefore likely to have been exposed to the virus) found all were negative [5]. Human infection with HeV is notifiable in all states and territories except Vic and Tas.

For more information see "Hendra virus – CDNA National Guidelines for Public Health Units" (Department of Health and Aged Care) https://www.health.gov.au/resources/publications/hendra-virus-cdna-national-guidelines-for-public-health-units [6].

Natural hosts

There are four species of flying-fox on mainland Australia: black flying-fox (*Pteropus alecto*; BFF); spectacled flying-fox (P. *conspicillatus*; SFF); little red flying-fox (*P. scapulatus*; LRFF) and grey-headed flying-fox (*P. poliocephalus*; GHFF). Serologic evidence of HeV infection has been found in all four species [7]. Research suggests that two species, the BFF and SFF, are the primary reservoir hosts of the first identified HeV variant (HeV-g1) [8-11]. A second variant of HeV (designated HeV-g2) was discovered in a GHFF in 2013. Since then, HeV-g2 has been identified in GHFF in Vic, NSW, Qld, and SA, BFF in NSW and Qld, and a LRFF in WA [12, 13].

An extensive search for the natural host of HeV was undertaken in the locations where the first equine cases were identified. A wide range of wild animals were tested for the presence of antibodies, including insectivorous bats, birds, reptiles, amphibians and insects. Other than flying-foxes, **no evidence** of HeV infection was found. [7, 14, 15]. Serological surveys of horses [16] and other domestic animals, including cattle, dogs, cats and poultry were negative.

Other hosts

In experimental studies, HeV has been shown to infect horses, ferrets, pigs, cats (including cat to horse transmission), African green monkeys (*Chlorocebus sabaeus*), mice, guinea pigs and hamsters [17, 18]. There is one recorded case of natural HeV infection in a domestic dog, confirmed by PCR [19], and one reported case of seroconversion [20]; in both cases the dogs were living on properties where equine cases of HeV occurred [4].

World distribution

HeV infection has only been reported from Australia. However, HeV neutralising antibodies have been reported in six species of flying-fox from Papua New Guinea [21]. It is possible that these reports reflect previous HeV infection or cross-neutralisation with Nipah virus or an unidentified henipavirus.

Related henipaviruses have been found in bats in Australia, Asia, and Africa [22], and it is probable that more will be found. The most notable is Nipah virus, which causes mortalities in animals and humans in Asia [23] [see also WHA Fact Sheet "*EXOTIC-Henipah viruses*"].

Occurrences in Australia

Over 65 HeV disease events in horses have been reported to December 2023, involving more than 100 confirmed or possible cases [24]. Disease in humans has occurred in five events, involving seven human cases (four were fatal) [25]. HeV-g2 has been associated with fatal illness in a horse in 2015, and again in 2021 near Newcastle, NSW [26, 27].

Cedar virus (CedV) is a related virus isolated from flying-fox urine in Qld and Vic [28, 29]. The clinical significance of CedV is unknown, although it has displayed a low pathogenicity in experimentally infected animals [30].

Epidemiology

Infection in flying-foxes and viral shedding

HeV infections occur in flying-foxes across much of Australia [11, 12, 31], with serological evidence of exposure in individuals from WA, NT, Qld, and NSW [7]. Based on rates of detection of the virus itself, **BFF** and **SFF** appear to be the primary reservoir hosts for HeV-g1 and the primary source of HeV infection in horses [8, 9, 32, 33]. **HeV-g2** has been detected in samples from GHFF, LRFF and BFF, however little is known about the potential role of each species in the epidemiology of HeV-g2 [12, 13]. Mortality and morbidity have not been reported for infected flying-foxes, [8, 34, 35] indicating that the direct impact of HeV on flying-fox populations is likely to be minimal.

Flying-fox **urine** is believed to be the most important route of excretion of HeV [10, 11]. Transmission between flying-foxes appears efficient, indicated by wide distribution of high seroprevalence in flying-fox colonies [31], and likely involves direct contact with urine of conspecifics [10]. Vertical transmission *in utero* has been identified [36], however evidence suggests it is not a consistent mode of transmission [8]. Latent infection (where the virus persists in a dormant state in the host) with recrudescence (recurrence) may be an important factor in transmission dynamics in flying-fox communities, although further investigation is required [10]. There is no evidence that arthropod vectors contribute to HeV transmission [37].

Viral infection and shedding fluctuates [15], with individual flying-foxes experiencing a short viraemic period [10]. Shedding occurs intermittently rather than continuously at a population level, and often in temporally and spatially restricted pulses [11]. The largest pulses tend to occur over winter in the subtropical regions of southern Qld and northern NSW [2, 32]. See "*Drivers of spillover*" below, for more information.

Infection in horses and humans

Hendra virus spillover from flying-foxes to horses likely has complex causality involving multiple host and environmental factors. Paddock-housed horses are most at risk and are likely exposed when infectious urine, bodily fluids or excretions of flying-foxes come into contact with a horse's mucous membranes [7, 32, 34, 36]. This is thought to occur directly or indirectly (e.g. via contaminated pasture, feed or water) [10, 25, 32].

The **incubation period** for horses is believed to be 5-16 days [38, 39]. The reported incubation period in humans is similar [40] or possibly longer (up to 21 days) [41]. Horses may be able to shed virus for 2 days prior to the onset of clinical signs [42].

Close contact between horses, or between horse and human, appears necessary for the onward spread of infection [34, 42]. Viral loads in acutely infected horses are usually very high [4] but horse-to-human transmission is considered to be inefficient. Procedures undertaken by affected veterinarians and assistants (including endoscopy of the respiratory tract and necropsy) may have significantly increased their exposure to the virus. There is no evidence of spread of HeV from

flying-foxes to any species other than horses and no evidence of human-to-human spread. Other mammals, including dogs, may become infected following exposure to viraemic horses. There is a potential risk of transmission from infected dogs to humans [43]. While there is evidence of recrudescence (recurrence) of HeV infection in humans, experimental studies indicate convalescent animals are not likely to be an infection risk for humans [44].

HeV infection in horses has occurred along the east coast of Australia from far north Qld to the north coast and Hunter Region of NSW, with most spillovers occurring in southern Qld and northern NSW [9]. The geographic spread of outbreaks of HeV-g1 in horses falls entirely within the range of the BFF and most events occur in winter, in the southernmost part of this species distribution [32, 33]. In subtropical Australia, the winter seasonality of equine HeV cases mirrors the winter peaks of HeV excretion in pooled flying-fox urine samples [2, 32]. Excreted HeV may survive for longer at cooler temperatures [45].

Drivers of spillover

The environmental and anthropogenic drivers of HeV spillover are well studied. Understanding these drivers is critical to predicting spillover risk.

Investigations into the drivers of HeV excretion from flying-foxes suggest a complex and dynamic process, however rapid documented changes in flying-fox behaviour have been shown to coincide with the emergence of HeV, and there are clear associations between HeV shedding and winter nutritional stress or climate-driven food shortages [2, 3, 46, 47]. Flying-foxes require flowering and fruiting plants as food sources, as well as suitable roosting sites. Winter peaks of HeV shedding in flying-foxes are amplified in populations roosting outside of their historic winter range and in years following a period of food shortage for flying-foxes [3].

Loss of critical winter-flowering plants (due to land clearing) and climate-driven food shortages are driving flying-foxes to move to and stay in agricultural and urban areas [2, 3]. This increases the risk of spillover in two ways: nutritional stress due to food shortage increases the amount of virus shed from flying-foxes, and increased presence of flying-foxes in agricultural and urban areas results in more contact with horses [2, 3, 48]. A highly predictable pattern is present: strong El Niño events (warm, dry winters) lead to acute food shortages for flying-foxes in the following spring, and an increased risk of HeV spillovers in the subsequent winter unless there is an abundant flowering of winter-flowering eucalypts [3]. The emergence and increase in HeV spillovers has been linked to the ongoing decline of native flying-fox foraging habitat. Good winter flowering events in remaining habitat appear to reduce spillover risk. Solutions for prevention of future spillovers may lie in restoration of critical winter-flowering native habitat [3].

Flying-foxes provide ecosystem services in the form of pollination and seed dispersal, which are of significant ecological and economic value [49], however their presence near human habitation often causes conflict. As natural habitat continues to decline, Australian flying-foxes are likely to continue to move into urban and peri-urban areas, driven by the search for suitable food and roosting sources [50, 51].

Clinical signs

No clinical signs have been observed in wild or experimentally infected flying-foxes [8, 34, 35].

Horse: acute onset of clinical signs; pyrexia, increased heart rate, difficulty breathing and rapid progression to death associated with either respiratory or neurological signs. Colic and acute death have also been reported [52]. Case fatality rate is 75% [3] with some horses surviving and seroconverting prior to euthanasia [38, 53]. Horses that become sick with HeV-g2 appear to show similar signs to HeV-g1 [26].

Human: fever, neurological or respiratory signs and symptoms, and death [54].

Diagnosis

HeV has been detected in a range of tissues and fluids from flying-foxes including urine, serum, spleen, kidney, uterine fluid, foetal tissues, saliva, lung, liver, and urogenital, nasal, oral and rectal swabs [8, 10, 36]. Spleen and urine report the highest detection rates in infected flying-foxes [8, 10, 12].

Laboratory diagnostic specimens and laboratory procedures

HeV is a Physical Containment Level 4 (PC4) pathogen (highest risk). Samples should only be collected when the risk of human exposure can be adequately managed. **Necropsy of diseased animals may be very high risk** and is not required for diagnosis of the disease in horses. Full necropsy of suspect or confirmed cases and virus culture should only be conducted under high-biosecurity conditions. Diagnostic tests for HeV include virus isolation, the detection of nucleic acids or serology [55].

Flying-fox: testing of individual flying-foxes should not be used for the purpose of assessing risk following contact between a flying-fox and another animal. Risk assessment for these situations should be conducted on a case-by-case basis using the circumstances alone. For research purposes, testing may be performed by serology or PCR of urine (RT-PCR) - either collected individually or pooled from under roost trees [10, 11]. PCR assays have been developed for both HeV variants [12, 56]. Virus has been isolated from urine, uterine fluid, foetal liver/lung, kidney, blood, heart and spleen [57].

For more information consult “Hendra Virus Testing in Individual Flying-foxes at Necropsy” (https://wildlifehealthaustralia.com.au/Portals/0/ResourceCentre/BatHealth/HeV_testing_individual_flying-foxes_V2.1_Nov2016.pdf) [57].

Horses: see Qld “Guidelines for veterinarians handling potential HeV infection in horses” www.business.qld.gov.au/industries/service-industries-professionals/service-industries/veterinary-surgeons/guidelines-hendra and NSW “Hendra virus information for vets” www.dpi.nsw.gov.au/about-us/services/laboratory-services/veterinary/hendra-virus for sampling, packaging, and transport requirements.

Human: see “Hendra virus – CDNA National Guidelines for Public Health Units” (Department of Health and Aged Care) www.health.gov.au/resources/publications/hendra-virus-cdna-national-guidelines-for-public-health-units [6].

Clinical pathology

Flying-fox: haematologic and biochemical values for HeV positive individuals fall within normal reference ranges, however studies show HeV-positive black flying-foxes tended to have significantly higher lymphocytes, ALP, urine protein and significantly lower neutrophils and plasma triglycerides than HeV-negative individuals [58].

Pathology

Flying-fox: no gross lesions. Mild vasculitis has been observed in the lung, spleen, meninges, kidney and heart on histology in some cases of experimental infection [34, 35, 42]. HeV-g2 was associated with vasculitis in one grey-headed flying-fox [12].

Treatment

Treatment of flying-foxes is neither appropriate nor necessary as infection is sub-clinical. Information on options for human treatment is available through the Qld and NSW Departments of Health. A post-exposure monoclonal antibody that has successfully undergone human trials is available for compassionate use in humans [59].

Equine cases and canine cases were formerly euthanased to prevent risk of further disease transmission. Research has now established there is **no evidence that recovered horses shed infectious virus** [17, 44] and previous government policy regarding euthanasia of seropositive, recovered horses was reviewed in 2016, so that **compulsory euthanasia of recovered horses is no longer mandatory** [60]. Management of seropositive non-vaccinated horses is at the discretion of the state Chief Veterinary Officer [60].

Prevention and control

Prevention of infection in horses and humans is aided by the use of vaccination in horses, limiting exposure of horses and their feed to flying-fox contamination, and by use of appropriate personal protective equipment, particularly when dealing with sick horses and undertaking post-mortem examination of suspect equine cases. Post-mortem examination is believed to carry the greatest risk for human infection [61] and some potential transmission risk exists prior to the onset of clinical signs in horses.

It is strongly recommended that sick horses are isolated from other horses, people, and pets (including dogs and cats) until veterinary opinion can be obtained.

Refer to the following guidelines for further information:

Veterinarians: www.business.qld.gov.au/industry/service-industries/veterinary-surgeons/guidelines-hendra (Qld) and www.dpi.nsw.gov.au/about-us/services/laboratory-services/veterinary/hendra-virus (NSW)

Horse owners: www.business.qld.gov.au/industry/agriculture/animal-management/horses/hendra-virus-owners (Qld) and www.dpi.nsw.gov.au/animals-and-livestock/horses/health-and-disease/hendra-virus (NSW).

A vaccine, Equivac HeV®, (www.zoetis.com.au/product-class/equivac-hev.aspx) is available for use in horses. Vaccinated horses receiving an initial course of three doses, followed by annual boosters, show robust immune responses and demonstrate antibody levels consistent with protective immunity against infection [44]. The vaccine is expected to be effective against HeV-g2. [26, 62]

Decontamination: see the guidelines above, and AUSVETPLAN Response Policy Briefs [60] for information. Specific testing of disinfectants against HeV has not been conducted, however HeV has a lipid envelope and this category of viruses are usually inactivated by soaps, detergents and many disinfectants [63].

Research

Key work has been undertaken on:

- ecology of HeV in Australian flying-foxes (including field transmission between bats and horses and its broader environmental and physiological drivers), risk mapping and prediction by Biosecurity Qld and university research groups.
- immunology and genomics of flying-foxes, henipavirus transmission and pathophysiology by CSIRO Australian Centre for Disease Preparedness.

Many knowledge gaps exist in our understanding of HeV. Unknown Hendra virus diversity and drivers of disease emergence are an important area of future study, and more work is required on many aspects of HeV ecology. The Joint Government Hendra Virus Taskforce established in 2011 funded 20 projects for HeV research, development and extension activities [64].

Surveillance and management

If HeV is suspected in horses, notify your local animal health authority immediately using the **Emergency Animal Disease Hotline 1800 675 888**. There is a legal obligation to notify. Investigation will be undertaken by jurisdictional biosecurity officers.

Hendra virus is a notifiable human disease in all states and territories except Vic and Tas. Suspected cases in humans should be reported, investigated, and treated as a matter of urgency. Contact a local doctor, emergency centre or the nearest Public Health Unit. People in Qld may contact the Qld Health 24-hour hotline on **13 HEALTH (13 43 25 84**), while those in NSW can contact their local Public Health Unit on **1300 066 055.**

The AUSVETPLAN Response Policy Brief for Hendra virus infection [60] details the national response policy for eradication of HeV infection in terrestrial animals. HeV is not a WOAH -listed disease.

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo-based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information https://wildlifehealthaustralia.com.au/Our-Work/Surveillance and

https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/eWHIS-Wildlife-Health-Information-System.

WHA is interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

Acknowledgements

We are grateful to the people who contributed to this fact sheet and would specifically like to thank Peter Holz, Hume Field, Ro McFarlane, Brent Jones, Avirup Sanyal, Belinda Linnegar and Alison Peel.

Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

Updated: April 2024

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Additional resources

In addition to the websites provided in the Fact Sheet see also:

Hendra Virus news updates provided by Qld Government
https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/animals/diseases/hendra

Compendium of findings from the National Hendra Virus Research Program
https://agrifutures.com.au/wp-content/uploads/publications/16-001.pdf

The Action Plan for Australian Bats – Australian Government Department of Sustainability, Environment, Water, Population and Communities [65].

To provide feedback on Fact Sheets

Wildlife Health Australia welcomes your feedback on Fact Sheets. Please email admin@wildlifehealthaustralia.com.au. We would also like to hear from you if you have a particular area of expertise and are interested in creating or updating a WHA fact sheet. A small amount of funding is available to facilitate this.

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