

Hendra Virus

CDNA National Guidelines for Public Health Units

Revision history			
Version	Date	Revised by	Changes
1.0	4 Nov 2010	Developed by Hendra SoNG working group	Endorsed by CDNA and AHPPC
2.0	9 Nov 2011	Hendra SoNG working group	Updated sections on disease, laboratory testing, case and contact management with new evidence. Exposure assessment form and fact sheets added. Endorsed by CDNA, noted by AHPC.
3.0	9 Nov 2016	Hendra SoNG working group	SoNG reviewed for currency. Updated sections on the disease, laboratory testing, vaccination in horses, factsheets and exposure assessment tool. Endorsed by CDNA, noted by AHPPC.

The Series of National Guidelines ('the Guidelines') have been developed by the Communicable Diseases Network Australia (CDNA) and noted by the Australian Health Protection Principal Committee (AHPPC). Their purpose is to provide nationally consistent guidance to public health units (PHUs) in responding to a notifiable disease event.

These guidelines capture the knowledge of experienced professionals and provide guidance on best practice based upon the best available evidence at the time of completion. Readers should not rely solely on the information contained within these guidelines. Guideline information is not intended to be a substitute for advice from other relevant sources including, but not limited to, the advice from a health professional. Clinical judgement and discretion may be required in the interpretation and application of these guidelines.

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Hendra virus

CDNA National Guidelines for Public Health Units

1. Summary

Public health priority

Urgent.

Case management

- Respond to a confirmed human case immediately on notification:
 - ensure appropriate infection control measures are in place;
 - ensure that consultation with an Infectious Diseases Physician occurs;
 - ensure liaison with appropriate animal health agency.
- Respond to a confirmed equine case, or where heightened suspicion of infection in a horse exists as advised by the relevant animal health agency, immediately on notification:
 - ensure appropriate infection control measures are in place;
 - establish an incident management team to manage the public health response to any confirmed human or equine case;
 - close liaison with animal health agencies is necessary – joint meetings should be held with relevant state or territory animal health agencies to ensure a coordinated response. An initial meeting should be held within 24 hours of notification.

Contact management

- Assess human exposure.
- If human exposure is categorised as high, or as having classification uncertainty (medium or high) using the Hendra virus exposure assessment form, refer as soon as practicable to an Infectious Diseases Physician for consideration of post-exposure prophylaxis.
- Advise all contacts to seek early medical advice if they develop fever, respiratory or neurological symptoms within three weeks of exposure.
- NOTE: In the event of a non-equine animal infection, see section 11. Contact management (below).

2. The disease

Infectious agents

Hendra virus (previously called equine morbillivirus) is a *paramyxovirus* of the genus *Henipavirus* (1). The other known agents in this genus are Nipah virus and Cedar virus.

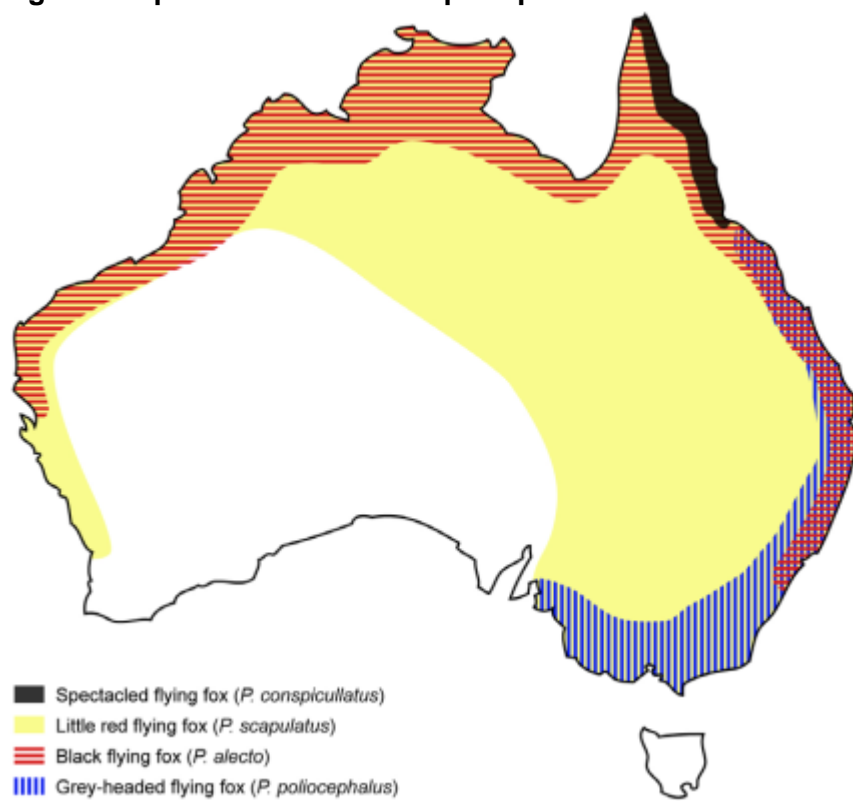
Reservoir

Flying foxes (bats of the genus *Pteropus*), also known as fruit bats, are the only known natural reservoir (2). The distribution of flying fox species in Australia is shown in Figure 1. All flying fox species are susceptible - antibody to Hendra virus has been found in 20-50 per cent of flying foxes in mainland Australian populations (3, 4). Since 1994, widespread testing

involving 46 other species of animals and arthropods has not shown the natural presence of the virus in any species other than flying foxes.

A three-year longitudinal study (2008-2011) conducted by Biosecurity Queensland, showed Hendra virus excretion in flying foxes can occur at any time of the year. However, the excretion normally occurs periodically rather than continuously, and in geographically-disparate flying fox populations in Queensland (5). Further research under the National Hendra Virus Research Program (funded by the Intergovernmental Hendra Virus Taskforce) which included the area from northern QLD to southern NSW (encompassing all known equine cases), identified a consistent, strong winter peaking of excretion in central and northern NSW and southern QLD (6). This study also provided supporting evidence that black and spectacled flying foxes are more likely to be associated with Hendra virus excretion than other species. These findings are consistent with the observed spatiotemporal pattern of infection in horses, and demonstrate that Hendra virus infection prevalence in flying foxes is a fundamental determinant of infection in horses.

Figure 1: Spatial distribution of pteropid bats in Australia¹



Mode of transmission

Bat-to-horse

Spillover from flying foxes to horses is rare, possibly occurring through contamination of horse feed, pasture and vegetation by infectious fluids from bats, e.g. bat urine/reproductive products. At the time of the first identified outbreak at Hendra (Brisbane, Queensland) in 1994, testing of nearly 2,000 horses across Queensland, including 906 horses within 1 km

¹ Since the spatial distribution of pteropid bats may change from year to year and from season to season, this figure is indicative only. Source: Hall L and Richards G (2000). Flying Foxes: Fruit and Blossom Bats of Australia, University of New South Wales Press Ltd, Sydney.

of quarantined properties, found no seropositive horses apart from those on the quarantined premises (i.e. no evidence of other spillover events) (7). Information on incidents by jurisdiction can be found at the [Australian Government national pests & diseases outbreaks website](http://www.outbreak.gov.au/pages/hendra-virus.aspx) (<http://www.outbreak.gov.au/pages/hendra-virus.aspx>).

Horse-to-person

Seven cases of human infection have been detected (as of July 2016), four of which have been fatal. One of the human deaths occurred 13 months after exposure to the virus, which occurred during the post-mortem examination of an affected horse. Notably, this case was hospitalised with aseptic meningitis shortly after exposure (see Case 3, Appendix 1).

All seven cases had a high level of exposure to respiratory secretions and/or other body fluids of horses subsequently diagnosed with Hendra virus infection, or presumed to have Hendra virus infection through review of clinical/epidemiological evidence in the absence of samples for laboratory testing. Three of the cases were exposed to tissues during post-mortem examinations on those horses. Two were probably exposed while performing nasal cavity lavage during the three days before the horse showed any clinical signs of disease. Further details on these cases are presented in Appendix 1.

No cases have been documented in people with medium or lower-exposure levels, including anyone appropriately using personal protective equipment (PPE) (8) and not all people with high-level exposures have become infected. On the evidence available, the most likely mode of transmission is via substantial direct exposure of mucous membranes (or non-intact skin) to respiratory secretions (including large droplets) or blood from an infected horse. Indirect exposure to respiratory secretions or blood, and direct or indirect exposure to other body fluids, may constitute less likely modes of transmission between horses and people. Current evidence does not support airborne exposure as a recognised mode of transmission.

Horse-to-horse

Transmission between horses has mainly occurred in situations of close contact and has been more efficient in stabled situations, with spread between multiple horses occurring in two events in stables (Hendra 1994 and Redlands 2008) and one event on a property with multiple small paddocks (Cawarral 2009), all in Queensland. It is possible that short-term survival of Hendra virus on environmental surfaces and inadvertent human-assisted fomite transmission (e.g. horse gear or veterinary equipment contaminated with secretions or fluids of an infected horse) may contribute to more efficient transmission in stabled situations. Of the 20 equine cases associated with the 1994 outbreak in Hendra, 18 occurred on the index property and the other two on the immediately adjacent property.

Bat-to-person

No evidence of bat-to-human transmission of Hendra virus. A study of 128 bat carers, the majority of whom reported daily contact with bats and/or a history of bat bites, found no individuals with antibodies to Hendra virus (9).

Person-to-person

There is no evidence of person-to-person transmission of Hendra virus. Serological testing in 169 health-care worker contacts and four household contacts of the first three human cases found no individuals with antibodies to Hendra virus (10). Testing of contacts of the subsequent four human cases also produced uniformly-negative results (11). Investigation of two of three surviving human Hendra virus cases found no evidence of prolonged virus

shedding following acute infection (12). However, recommendations are to avoid close contact with respiratory secretions and other body fluids of symptomatic human cases. As a precaution, standard, contact and droplet precautions, and airborne precautions for aerosol-generating procedures (13), should be implemented for management of suspected or confirmed human cases.

Person-to-horse

There is no evidence of person-to-horse transmission of Hendra virus (14). However, it is recommended that suspected human cases avoid close contact with horses until the diagnosis has been clarified and a case confirmed, until the possibly-human infectious period has passed.

Experimental

Disease has been induced under experimental conditions in cats, ferrets, hamsters, guinea pigs, horses and pigs. Experimentally-infected horses can excrete viral RNA in nasal secretions from three-five days before showing clinical signs of disease (15-17). This underpins recommendations that any procedures on apparently healthy horses that may cause aerosolisation or splashes, should be performed with appropriate infection control precautions including PPE. See section 9. Case management - Isolation and restriction for definitions of aerosols and droplets (below).

Other

Two dogs on properties with Hendra virus-infected horses have shown evidence of Hendra virus infection. The first antibody positive dog was identified in July 2011 on a property in Queensland where three horses developed Hendra virus infection. The second dog was identified in July 2013 on a NSW property where one horse had developed Hendra virus infection. Although the source of exposure for the dogs cannot be definitively ascertained, horse-to-dog transmission is the most plausible scenario given that both dogs had potential opportunity for exposure to infected horses. There is no evidence that bat-to-dog, dog-to-person, or dog-to-horse, transmission occurs.

Horses are considered to be the animal most associated with transmission due to their ability to amplify the virus. However, animal health experts believe dogs to be a potential transmission risk [refer to DRAFT V 4.0 AUSVETPLAN, in press].

Updated statistics on Hendra virus incidents, including locations, dates and confirmed horse cases, may be found on the [Queensland Government website](https://www.business.qld.gov.au/industry/service-industries/veterinary-surgeons/guidelines-hendra/incident-summary): (<https://www.business.qld.gov.au/industry/service-industries/veterinary-surgeons/guidelines-hendra/incident-summary>).

Incubation period

Humans

Hendra virus infection symptoms in humans have developed between five to 21 days after exposure to an infectious horse.

Horses

The incubation period in horses appears to be three-6 days, although the incubation period in one horse in the 2009 Bowen event may have been 31 days (personal communication,

Steven Donohue [Queensland Health] and Hume Field [Biosecurity Queensland], November 2009).

Infectious period

Humans

The potential infectious period in humans is unknown, as no evidence exists of person-to-person transmission to date. While the risk of transmission is probably negligible, for public health purposes, human cases should be considered potentially infectious while symptomatic.

Horses

Most transmission of Hendra virus to humans has occurred during contact after the infected horse had developed clinical signs of Hendra virus illness.

For human public health trace-back purposes, horses should be considered potentially infectious from 72 hours prior to the onset of clinical signs of disease. Careful assessment is required of how closely the horse was observed for the onset of illness.

Viral genetic material has been detected by PCR in experimentally-infected horses three-five days before the onset of symptoms (8, 16, 17). In this experimental study, the virus challenge was administered oronasally to three horses and viral genetic material was then identified in nasal swabs from each of the horses from two days post challenge. In the 2008 Redlands outbreak related to two humans, high-risk exposures (daily nasal cavity lavage) occurred during the last three days of the incubation period for one of the infected horses (11).

Given the theoretical potential for virus transmission beyond 72 hours prior to illness onset in the horse, individuals with specific medium-to-high or high-level exposure events (see Appendix 5: Exposure assessment form) in the 73-120 hours prior to the horse becoming sick, should be identified. Specifically, an invasive oral or respiratory tract procedure on the horse such as dental work and nasal endoscopy, without the use of appropriate use of infection control procedures including PPE. Detailed accounts of the specific exposures should be obtained and the significance of these exposures then considered by an expert panel.

Clinical presentation and outcome

Humans

The documented human cases to date have presented with:

- self-limiting influenza-like illness (two cases);
- influenza-like illness complicated by severe pneumonic illness contributing to death (one case);
- aseptic meningitis with apparent recovery, then death from encephalitis 13 months later (one case);
- acute influenza-like illness followed by encephalitis and seroconversion, followed by recovery (one case) and death (two cases).

Further detail on these seven cases is included in Appendix 1.

No cases of asymptomatic infection have been identified from extensive testing of human contacts associated with Hendra virus events up to July 2016.

Horses

In horses, Hendra virus has a clear predisposition for targeting endothelial cells of blood vessels, with clinical signs dependent on the sequence in which organs are affected. Documented equine cases to date have typically presented with acute onset of clinical signs, including increased body temperature and increased heart rate, and rapid progression to death associated with either respiratory or neurological signs (or a mix of these). Some horses have also shown evidence of multi-organ involvement.

The clinical signs, particularly of early Hendra virus infection, may be non-specific, although progression from onset to death is typically rapid, occurring over a couple of days. Less severe infections have been identified in horses being monitored during an outbreak; these horses are typically second or third-generation cases. From figures to date, approximately 75% of infected horses can be expected to die. Those that survive often have mild signs and seroconvert during the recovery period. In past incidents, all horses that have tested positive for Hendra virus have been euthanised (8). Please refer to the most recent [AUSVETPLAN Response Policy Brief for Hendra virus infection](#) for detail on current management of horses infected with Hendra virus: (<https://www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents/>)

Persons at increased risk of disease

People who are more likely to be exposed to infected horses may be at increased risk, e.g. veterinarians, horse trainers and stable workers.

Disease occurrence and public health significance

All events since Hendra virus infection was first identified in 1994 have occurred in Queensland or New South Wales. However, given the distribution of flying foxes (Figure 1) and frequency of horse movements among states and territories, cases could occur anywhere in Australia.

3. Routine prevention activities

- Veterinary practitioners and staff handling confirmed or suspected equine cases should follow appropriate infection control procedures, including wearing appropriate PPE (refer to 'Guidelines for veterinarians handling potential Hendra virus infection in horses' (8)).
- Horse owners or carers should minimise unnecessary human contact with sick horses and take appropriate preventive hygiene measures (refer to the Workplace Health and Safety Queensland document 'Hendra virus - information for horse properties and other horse related businesses' (18)).
- Horse owners and carers can take steps to protect horses from becoming infected with Hendra virus by reducing exposure to flying foxes, e.g. by placing feed bins and water troughs under cover and away from areas where flying foxes feed or roost (refer to the Workplace Health and Safety Queensland document 'Hendra virus - information for horse properties and other horse related businesses' (18) and [Biosecurity Queensland](#): (<https://www.business.qld.gov.au/industry/agriculture/animal-management/horses/hendra-virus-owners>)).
- An equine vaccine for Hendra virus infection in horses has been available in Australia since November 2012 (Equivac® HeV). The inactivated subunit vaccine has been shown to be safe and to provide high levels of protection in horses (19). The first dose of equine

vaccine may be administered to a horse from four months of age. Two initial doses are required with a minimum interval of three to six weeks, followed by a single booster at six months, then annual boosters. The Australian Pesticides and Veterinary Medicines Authority ([APVMA](http://apvma.gov.au/) (<http://apvma.gov.au/>)), which is responsible for assessment and registration of veterinary vaccines, registered the vaccine on 4 August 2015. The Equine Infectious Diseases Advisory Board supports the Australian Veterinary Association position in strongly recommending that all horses in Australia are vaccinated against Hendra virus. It has added the vaccine to the recommended vaccination schedule for horses. No human vaccine is available and the equine vaccine must not be used in humans.

4. Surveillance objectives

- To rapidly obtain confirmation of equine cases so that appropriate contact tracing and public health measures can occur.
- To rapidly confirm or rule out infection in humans.
- To rapidly identify human contacts and assess exposure risk.
- To ensure monitoring and appropriate referral of contacts with higher-risk exposure.
- To collect information about new human cases in order to broaden an understanding of this emerging infectious disease.

Surveillance for equine cases is the responsibility of animal health agencies. Appropriate processes should be in place to ensure relevant surveillance information is shared promptly at state and territory level among animal and human health agencies.

5. Data management

In states and territories where Hendra virus infection is notifiable, confirmed human cases should be entered onto the notifiable diseases database, ideally within one working day following notification.

6. Communications

- As soon as practicable and ideally within one hour of notification of confirmed human or equine cases, communication about the situation should occur between the public health authority and the central state or territory communicable diseases agency.
- As soon as practicable and ideally within four hours of notification, the central state or territory communicable diseases agency should notify the relevant animal health agency of any confirmed human case.
- As soon as practicable, and ideally within one working day, the central state or territory communicable disease agency should notify the CDNA via the secretariat.

7. Case definition

Hendra virus infection in humans is not currently nationally notifiable and there is no national case definition. The following is based on the Queensland case definition as at October 2011, reviewed in February 2015.

Confirmed case

A confirmed case requires laboratory definitive evidence

OR

Laboratory suggestive evidence **and** epidemiological evidence **and** clinical evidence.

Laboratory definitive evidence

Isolation of Hendra virus

OR

Detection of Hendra virus by nucleic acid testing

Laboratory suggestive evidence

Detection of antibody to Hendra virus by microsphere immunoassay, confirmed by specific immunofluorescent assay

OR

Detection of antibody to Hendra virus by virus neutralisation test

Epidemiological evidence

Exposure, within 21 days prior to onset of symptoms, to a horse with confirmed Hendra virus infection, or where heightened suspicion of Hendra virus infection exists as advised by the relevant animal health agency.

Clinical evidence

Clinically-compatible acute illness, (see section 2. The disease - Clinical presentation and outcome) (above).

NB: For case definitions in horses see the current AUSVETPLAN Hendra Virus Response Policy Brief (8).

8. Laboratory testing

Human testing may be indicated when there:

- has been significant exposure to confirmed or suspected equine cases; or
- is compatible human illness and testing is performed after consultation with an Infectious Diseases Physician.

As at July 2016, Queensland Health Forensic and Scientific Services (QHFSS) is the only human health laboratory in Australia that tests for Hendra virus. Tests available include nucleic acid testing (NAT) and serology. Virus isolation is usually attempted on acute phase specimens, particularly when NAT is positive.

Testing of human samples is also available, on request, from the Australian Animal Health Laboratory (AAHL), (Geelong, Victoria) and may be available on request from some state animal health laboratories. Tests available from AAHL include NAT, virus isolation and virus neutralisation test (VNT).

Nucleic acid testing (NAT)

NAT can be performed on respiratory samples (deep nasal swab or nasopharyngeal aspirate), serum (preferable to blood), cerebrospinal fluid (CSF), urine and tissue samples.

Minimum CSF, serum, liquid respiratory or urine sample volume is 0.5 ml. Tissue samples (minimum rice grain size) should be in viral transport medium, not fixed. Respiratory swab samples should be dry, or in viral transport medium. Chill all samples immediately upon collection (4°C) and transport cool (4°C), not frozen, within 24 hours.

Serology

QHFSS currently performs a screening microsphere immunoassay (MIA) for IgM and IgG and can differentiate between individuals with natural antibodies and those administered therapeutic monoclonal antibodies. If positive, the MIA is followed by a confirmatory immunofluorescence assay (IFA) that can be quantified. As with all serological tests, false positive results can occur. If MIA and IFA are positive in the absence of positive NAT, and if there is any question that this represents true infection, specimens may be referred to AAHL for VNT. Where serological testing is indicated, a baseline sample should ideally be collected as early as possible after exposure and stored for testing in parallel with subsequent samples. Minimum sample volume of CSF or serum is 0.5 ml. Transport cool (4°C) within 24 hours.

The earliest laboratory evidence of infection in human Hendra virus cases has been positive nucleic acid testing in blood, respiratory specimens, then urine, with serology becoming positive two to five days after onset of symptoms.

Recommendations

For suspected human cases:

- as a minimum, collect a dedicated blood sample (serum preferable) for NAT and a further sample for serology. Serology samples taken from a suspected case early in the illness may then be tested in parallel with samples taken later in the illness course;
- additional tests, depending on clinical picture may include deep nasal swab, nasopharyngeal aspirates and/or CSF/urine for NAT. In particular, urine (minimum volume 0.5 ml) and/or respiratory samples (note recommendations related to aerosol generating procedures in Section 9. Case management - Isolation and restriction) for NAT, may be used to supplement blood testing;
- tissue samples can be collected during post-mortem (or by pre-mortem biopsy where relevant) for NAT.

For human contacts of an equine case:

- if there is classification uncertainty (medium or high) or high exposure level, collect baseline serology and store for testing in parallel with follow up samples at three and six weeks after last exposure. The final six- week sample is taken as an additional precaution;
- if medium or lower exposure level, assess if symptoms develop and test as for suspected cases above where indicated.

9. Case management

Response times

Commence investigation immediately on notification of a confirmed human or equine case, or where notified by an animal health agency of heightened suspicion of infection in a horse on clinical and epidemiological grounds.

Response procedure

Case investigation – confirmed or suspected equine case

On notification of a confirmed equine case, or where an animal health agency has heightened suspicion on clinical and epidemiological grounds:

- Liaise with the animal health agency to:
 - ensure appropriate infection control measures (15) are in place for all confirmed or suspected equine cases. Biosecurity officers will determine if property quarantine, livestock quarantine (including using PPE) and/or travel restrictions for close contact horses are required. This will take into consideration if the horses have received an appropriate course of HeV vaccine. Refer to current [AUSVETPLAN](#) for further information (DRAFT V 4.0 AUSVETPLAN, in press);
 - clarify timeline for results of laboratory testing when not already confirmed;
 - establish whether/what communication has occurred with potential human contacts.
- Identify and manage human contacts.

Case investigation – confirmed or suspected human case

On notification of a confirmed human case, or where a public health unit considers there is heightened suspicion on clinical and epidemiological grounds:

- Liaise with the treating clinician to:
 - ensure appropriate infection control measures (see Isolation and Restriction section below) are in place;
 - ensure consultation with an infectious diseases physician.
- Facilitate urgent laboratory testing where not already confirmed.
- Identify any exposures to known equine cases and other equine exposures where relevant.
- Identify and manage human contacts.
- Liaise with senior staff in the relevant state or territory animal health authority to:
 - alert them to the human case;
 - discuss need for testing of relevant horses, where appropriate;
 - establish whether/what communication has occurred with potential human contacts of relevant horses.

Response management – confirmed equine or human case

For all confirmed human or equine cases, an incident management team should be established to manage the public health response.

Close liaison with the relevant state or territory animal health agency is necessary and regular interagency meetings should be held to ensure a coordinated response. Relevant state or territory workplace health and safety agencies should be involved early if the event occurs in a workplace.

Case treatment

Responsibility of the treating medical practitioner. Advice should be sought from an infectious diseases physician.

Education

Cases should be informed about the nature of infection, mode of transmission and other relevant information.

Isolation and restriction

- While there is no evidence of human-to-human transmission, standard, contact and droplet precautions (13) should be in place for all visitors and health-care workers caring for symptomatic persons suspected or known to be infected with Hendra virus. Additional precautions may be ordered at the discretion of the treating infectious diseases physician.
- Airborne precautions should be implemented during any aerosol-generating procedures [(13).
- Confirmed cases should avoid close contact with animals during acute illness.
- Confirmed cases should never subsequently donate blood or any other tissue, even if they recover. Local public health unit to liaise with Australian Red Cross Blood Service to record Hendra virus infection status for case.

Aerosols: Microscopic particles < 5 µm in size that are the residue of evaporated droplets and are produced when a person coughs, sneezes, shouts, or sings. These particles can remain suspended in the air for prolonged time periods and can be carried on normal air currents in a room or beyond, to adjacent spaces or areas receiving exhaust air.

Droplets: Small particles of moisture generated when a person coughs or sneezes, or when water is converted to a fine mist by an aerator or shower head. These particles, intermediate in size between drops and droplet nuclei, can contain infectious microorganisms and tend to quickly settle from the air such that risk of disease transmission is usually limited to persons in close proximity (e.g. at least one metre) to the droplet source.

Source: [National Health and Medical Research Council](#)

10. Environmental evaluation

State and territory animal health agencies are responsible for managing confirmed or suspected equine cases to prevent exposure to other horses, domestic animals or people. For confirmed equine cases, this may include quarantining the property, euthanising the infected horse or horses, tracing of animals that have recently moved from the property, isolating and testing other animals that may have been exposed, and vaccinating other horses on the property. Quarantining the property allows animal health agencies to prevent or control movements of potentially-infectious animals, products and fomites on the property, and is common in managing many notifiable diseases of livestock.

Hendra virus is killed by heat, drying and cleaning with detergents, so disinfecting contaminated fomites and surfaces on the property is usually allowed to occur naturally over time. In past incidents, confirmed equine cases have been euthanised in accordance with nationally-agreed policy, to prevent further risk of transmission, provided it is done humanely and the carcass is safely disposed of. Please refer to the most recent [AUSVETPLAN policy for Hendra virus infection](#) for detail on current management of horses infected with Hendra virus (<https://www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents/>).

Animals (including horses and other domestic animals such as dogs) that may have been exposed, are isolated from other animals on the property and a series of tests are performed over a number of weeks to determine whether they have become infected. Vaccination of

other horses on the property may be recommended. Once the remaining animals on the property are shown to be free of infection, the property is released from quarantine (8).

Suspected equine cases (those with consistent clinical signs) are isolated from other animals on the property and human contact with the horse is minimised until test results are available. If contact with the horse cannot be avoided given that it may require high levels of care due to illness, advice will be provided by animal health authorities to the owner or carer on appropriate infection control procedures, including using PPE. Private veterinarians attending suspected equine cases will use PPE during examinations and any associated procedures due to the exposure risk associated with such contact with the horse. Owners will also need to practise infection control procedures as advised by the attending private veterinarians, in compliance with workplace health and safety requirements.

In the past, researchers have visited properties where infection has been confirmed, to look for evidence of recent flying fox activity, in an to attempt to identify possible risk factors for transmission of virus from bats to horses, by profiling case properties. This is separate from the response mounted by animal health authorities, but helps to provide information on how to prevent future spillover of Hendra virus to horses. Such visits are likely to continue while research funding is available.

In human health-care facilities, environmental cleaning procedures should be conducted in accordance with Australian infection control guidelines (13).

11. Contact management

Identification of contacts

The aim of identifying contacts is to:

- assess exposure and provide advice about level of risk and other relevant information;
- refer for consideration of post-exposure prophylaxis on advice of an expert panel (described below).

Contact definition

Contact of equine case

People who have had direct or indirect exposure of skin or mucous membranes to body fluids (including sharps injuries) of a horse, determined by the relevant state or territory animal health agency to be a confirmed case of Hendra virus infection, or of a horse where heightened suspicion of infection exists on clinical and epidemiological grounds as advised by the relevant animal health agency.

Contact of human case

People who have had close contact with a symptomatic confirmed human case or person where heightened suspicion of infection exists on clinical and epidemiological grounds as determined by the relevant public health unit (including household or household-like contacts, sexual partners, and anyone with direct or indirect exposure of skin or mucous membranes to body fluids).

Contact of non-equine animal infections, detected through on-property surveillance

A detailed understanding of human contact with the animal should be obtained and expert advisory group input should be sought.

Investigation

Exposure assessments of human contacts are required for all confirmed equine cases of Hendra virus infection, and where heightened suspicion of infection in a horse exists on clinical and epidemiological grounds as advised by the relevant animal health agency. Exposure assessment of human contacts of confirmed human cases is also recommended. Although risk is generally likely to be negligible, the assessment and provision of information will often provide valuable reassurance.

Obtain information from relevant state or territory animal health agencies on all horses with confirmed Hendra virus infection, and any epidemiologically-linked equine cases where heightened suspicion of Hendra virus infection exists on clinical and epidemiological grounds (this may include previously sick horses associated with affected properties). Trace-back investigations by the animal health agency of horse movements from affected properties may generate considerable workload for public health units by identifying other humans requiring follow-up as contacts of additional equine cases.

Develop a line listing of all people who may have been in contact with confirmed equine cases, or where heightened suspicion of infection in a horse exists on clinical and epidemiological grounds as advised by the relevant animal health agency (contacts of human cases are a lower priority as they are likely to be at negligible risk).

For all human contacts of confirmed equine cases:

- assess exposure (using Appendix 5: Exposure assessment form) and current health status;
- if exposure is classified as high or as having classification uncertainty (medium or high) using the exposure assessment form, liaise with an infectious diseases physician as soon as practicable for consideration of post-exposure prophylaxis;
- if assessed as medium exposure, discuss as soon as practicable with other appropriately-experienced public health practitioners and infectious diseases physician/s to reach consensus on exposure assessment;
- refer any symptomatic people to appropriate care;
- provide information about Hendra virus;
- counsel about risk;
- provide advice about testing recommendations (see section 8. Laboratory testing) (above);
- provide advice about self-monitoring of the contact's health, and advise the person to seek early medical advice if they develop fever or respiratory or neurological symptoms within three weeks of exposure, phoning ahead of the visit so that appropriate infection control measures can be put in place (see section 9. Case management [above]); Appendix 3: Information for people exposed to a horse infected with Hendra virus; and Appendix 4: Hendra virus infection information for Health-care Workers).

The urgency of response to illness in contacts depends on the assessed level of exposure. Clinically-compatible illness (respiratory or neurological symptoms) in a person classified as having high exposure or as having classification uncertainty (medium or high) using the

exposure assessment form, should be urgently assessed by or in liaison with an infectious diseases physician.

Further advice for exposure assessment:

- it is best to refer to horses by their popular (or most commonly used) name, to minimise confusion;
- determine the level and type of contact between the person and the equine (or human) case/s;
- re-interviewing contacts of equine cases may identify useful new information;
- it may be necessary to clarify terminology relating to equine surface anatomy and equine handling to ensure a clear understanding between the interviewer and interviewee.

As psychological stress and the exacerbation of existing health issues may result from a Hendra virus incident, everyone involved should be strongly encouraged to access their usual health-care practitioner to assess need for ongoing physical and psychological support, medical or workers' compensation certification and referral to other services as necessary. GPs should be provided with appropriate information and resources, including local public health unit contact details. Initial contact with GPs should preferably be by telephone.

Prophylaxis

No drug or product is of proven benefit in humans, although monoclonal antibodies show the most promise. Monoclonal antibodies have been shown to protect ferrets from serious disease when given 10 hours after exposure to Nipah virus (20) and when given 10-12 hours after exposure to Hendra virus (personal communication, Deborah Middleton, CSIRO, 20 September 2011). They have also been shown to protect African green monkeys from fatal infection when given 72 hours after exposure to a lethal dose of Hendra virus (21).

As at July 2016, monoclonal antibody had been used on compassionate grounds in 11 people. A Queensland Department of Health and University of Queensland clinical trial to further evaluate the safety of monoclonal antibodies in humans, has been completed at the time of writing, with results awaited.

Wherever possible, an expert panel of public health and infectious diseases practitioners with appropriate experience should be convened as part of the incident management process to review all contacts identified as having classification uncertainty (medium or high) or high-level exposures. The panel will advise whether monoclonal antibody should be offered and on any logistical issues.

The only stock of monoclonal antibodies (as at July 2016), is held in Queensland, access to which for contacts with high-level exposures, can be sought via the Executive Director, Communicable Diseases Branch, Queensland Health.

Education

Provide information about the disease to all contacts of confirmed human and equine cases, and contacts of horses or humans where heightened suspicion of infection exists on clinical and epidemiological grounds, as respectively advised by the relevant animal health agency or determined by the relevant public health unit.

If an equine case is confirmed, it may be appropriate for human health agency officers to visit the property to provide information and support to key people (e.g. owners and managers) and to assist animal health agency staff in providing information to the local

community. Any site visit should complement and not delay the full public health response, which focuses on the timely assessment of exposure and current health status of all people who may have been exposed to infected horses, including animal health practitioners, many of whom may not be available on site.

Hendra virus incidents may be very stressful for people exposed or otherwise involved. Relevant points for stress responses include:

- Hendra virus infection is a rare disease with a high mortality rate;
- aspects of the disease are poorly understood, with treatment and prophylaxis still being tested;
- Hendra virus has been subject to intense media interest;
- the potential for major effects on the business/livelihood of those involved;
- the death or euthanising of horses, but rarely, other animals;
- social isolation of people based at an infected property.

Horse owners are likely to see animal health agency staff arrive with extensive PPE such as full-length fluid resistant overalls, face shields and respirators. Despite explanations (ideally prior to staff arriving), that the use of PPE is a standard, precautionary measure, some people may interpret incorrectly, that Hendra virus is highly infectious and that they are at significantly increased risk of infection and death. All closely-involved persons including family members, owners, and others, and those with minimal exposure, may require repeated reassurance and information. The local community may also need relevant information early in the management of the incident, to minimise misunderstanding and misinformation.

Isolation and restriction

- No restrictions are required on the movements or activities of asymptomatic human contacts of an infected animal or human.
- Symptomatic contacts should be managed with standard, contact and droplet precautions. During any aerosol-generating procedures on a symptomatic human contact, airborne precautions should be implemented (13).
- Contacts of an infected animal or human should not donate blood or any other tissue until cleared by absence of illness over three weeks since last exposure (and negative test results were indicated).

12. Special situations

Nil

13. References and additional sources of information

1. Mahalingam S, Herrero LJ, Playford EG, Spann K, Herring B, Rolph MS, et al. Hendra virus: an emerging paramyxovirus in Australia. *The Lancet Infectious diseases*. 2012;12(10):799-807. Epub 2012/08/28.
2. Halpin K, Hyatt AD, Fogarty R, et al. Pteropid bats are confirmed as the reservoir hosts of henipaviruses: A comprehensive experimental study of virus transmission. *The American journal of tropical medicine and hygiene*. 2011;85(5):946-51.
3. Australian Biosecurity CRC for Emerging Infectious Disease. Research Update: Hendra Virus. 2009; Available from: http://www1.abccrc.org.au/uploads/8aee9ac0-1355-4339-b5b6-5772a4ee6cf7/docs/HeV_Review_updated170909.pdf.
4. Field H. The ecology of Hendra virus and Australian bat lyssavirus (PhD Thesis). Brisbane, Australia: The University of Queensland; 2004.
5. Field H, de Jong C, Melville D, Smith C, Smith I, Broos A, et al. Hendra virus infection dynamics in Australian fruit bats. *PloS one*. 2011;6(12):e28678. Epub 2011/12/17.
6. Field H, Jordan D, Edson D, Morris S, Melville D, Parry-Jones K, et al. Spatiotemporal Aspects of Hendra Virus Infection in Pteropid Bats (Flying-Foxes) in Eastern Australia. *PloS one*. 2015;10(12):e0144055. Epub 2015/12/02.
7. Murray K, Rogers R, Selvey L, Selleck P, Hyatt A, Gould A, et al. A novel morbillivirus pneumonia of horses and its transmission to humans. *Emerging infectious diseases*. 1995;1(1):31.
8. Animal Health Australia. Response policy brief: Hendra virus (formerly equine morbillivirus) infection (Version 4.0). . Canberra, ACT: 2016.
9. Arklay A, Selvey L, Taylor R, Gerrard J. Screening of bat carers for antibodies to equine morbillivirus. *Communicable Diseases Intelligence*. 1996;20(22):477.
10. McCormack JG, Allworth AM, Selvey LA, Selleck PW. Transmissibility from horses to humans of a novel paramyxovirus, equine morbillivirus (EMV). *Journal of Infection*. 1999;38(1):22-3.
11. Playford EG, McCall B, Smith G, Slinko V, Allen G, Smith I, et al. Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008. *Emerging infectious diseases*. 2010;16(2):219.
12. Taylor C, Playford EG, McBride WJH, McMahon J, Warrilow D. No evidence of prolonged Hendra virus shedding by 2 patients, Australia. *EID*. 2012;18(12):2025-7.
13. National Health and Medical Research Council. Australian Guidelines for the Prevention and Control of Infection in Healthcare (2010). 2010.
14. Hess IMR, Massey PD, Walker B, Middleton DJ, Wright TM. Hendra virus: What do we know? *NSW Pub Health Bull*. 2011;22(5-6):118-22.
15. [State of Queensland DoA, Fisheries and Forestry. Guidelines for veterinarians handling potential Hendra virus infection in horses. 2014;](https://www.daff.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus/veterinarian-guidelines) (<https://www.daff.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus/veterinarian-guidelines>).
16. Middleton D. Initial experimental characterisation of HeV (Redland Bay 2008) infection in horses. 2009.
17. Marsh GA, Haining J, Hancock TJ, et al. Experimental infection of horses with Hendra Virus/Australia/Horse/2008/Redlands. *EID*. 2011;17(12):2232-8.
18. Workplace Health and Safety Queensland. Hendra virus – information for horse properties and other horse businesses. Office of Industrial Relations; 2015 [18/1/2017]; (https://www.worksafe.qld.gov.au/__data/assets/pdf_file/0009/82989/alert-hendra_virus_horse.pdf).
19. Equine Veterinarians Australia (EVA). The Hendra vaccine: your questions answered. 2013; (<http://www.ava.com.au/sites/default/files/Hendra%20FAQ%20brochure%20NO%20PRINTED%20MARKS.pdf>).

20. Bossart KN, Zhu Z, Middleton D, Klippel J, Crameri G, Bingham J, et al. A neutralizing human monoclonal antibody protects against lethal disease in a new ferret model of acute nipah virus infection. PLoS pathogens. 2009;5(10):e1000642. Epub 2009/11/06.
21. Bossart KN, Geisbert TW, Feldmann H, Zhu Z, Feldmann F, Geisbert JB, et al. A neutralizing human monoclonal antibody protects african green monkeys from hendra virus challenge. Science translational medicine. 2011;3(105):105ra3. Epub 2011/10/21.
22. Selvey LA, Wells RM, McCormack JG, Ansford AJ, Murray K, Rogers RJ, et al. Infection of humans and horses by a newly described morbillivirus. The Medical journal of Australia. 1995;162(12):642-5.
23. O'Sullivan J, Allworth A, Paterson D, Snow T, Boots R, Gleeson L, et al. Fatal encephalitis due to novel paramyxovirus transmitted from horses. The Lancet. 1997;349(9045):93-5.
24. Hanna JN, McBride WJ, Brookes DL, Shield J, Taylor CT, Smith IL, et al. Hendra virus infection in a veterinarian. Medical Journal of Australia. 2006;185:562-4.

14. Appendices

Appendix 1: Summary of human cases of Hendra virus infection

Appendix 2: Fact Sheet: Hendra Virus Infection

Appendix 3: Information for people exposed to a horse infected with Hendra virus

Appendix 4: Hendra virus infection information for Health-care Workers

Appendix 5: Exposure assessment form

Appendix 6: Public health checklist

15. Jurisdiction specific issues

[Links to State and Territory Public Health Legislation, the Biosecurity Act 2015 and the National Health Security Act 2007.](#)

Appendix 1: Summary of human cases of Hendra virus infection

Cases 1 and 2

In Hendra (a suburb of Brisbane) in 1994, a 49-year-old horse trainer died after a fulminating pneumonic illness, and a 40-year old stable worker survived an influenza-like illness. These two cases occurred following a sudden outbreak of an acute respiratory syndrome among thoroughbred horses in a training complex. Both human cases had extensive close contact with respiratory secretions and other body fluids of several very ill horses (22). The incubation periods of the two cases were estimated to be five and six days. Surveillance of about 90 other people exposed to infected horses identified no other human cases (22).

Case 3

In 1995 in Mackay, north Queensland, a 36-year-old horse trainer died from severe encephalitis caused by Hendra virus. Subsequent investigations indicated he had been exposed to Hendra virus 13 months earlier whilst assisting a veterinarian undertake a post-mortem examination on two horses. He also had direct ante-mortem exposure to their respiratory secretions (23) (personal communication, Simon Bewg, Biosecurity Queensland, September 2006). Of note, he was hospitalised with aseptic meningitis shortly after exposure to the horses, with recovery at the time and a long symptom-free period before his fatal illness. This initial illness was considered to have been a seroconversion illness, with an anamnestic response to viral antigens in the second and fatal illness (reinfection with Hendra virus or alternative cause of fatal illness both considered unlikely explanations). The veterinarian who conducted the post-mortem examination remained well.

Case 4

In Cairns, north Queensland in late 2004, a veterinary practitioner aged in her 20s, performed a post-mortem examination on a horse subsequently presumed, based on clinical and epidemiological evidence, to have died of Hendra virus infection. The veterinarian had also attended to the horse in the last few minutes of its life and was extensively exposed to respiratory secretions and blood. About seven days later, she developed a mild influenza-like illness and showed evidence of seroconversion to Hendra virus. At follow-up four years later, she remained well. Three other people who were also exposed remained well and did not seroconvert (24).

Cases 5 and 6

In July 2008, a veterinary hospital at Redlands (a suburb of Brisbane), was quarantined after four horses with neurological signs tested positive to Hendra virus. Another horse developed clinical signs while under quarantine. Two of the staff members caring for the horses in the clinic prior to confirmation of Hendra virus infection, developed an acute influenza-like illness followed by encephalitis and seroconversion to Hendra virus. One of them subsequently died. One case was exposed to the virus during post-mortem examination of a horse subsequently confirmed as infected with Hendra virus (possible 16-day incubation period) and both cases were exposed while performing nasal cavity lavage in the three days before the onset of clinical signs of disease in another horse (possible incubation periods of nine and 11 days) (11).

Case 7

In August 2009, at an equine nursery at Cawarral near Rockhampton, central Queensland, a 55-year-old veterinarian performed a nasal endoscopy on a horse that was subsequently

presumptively diagnosed (based on both clinical signs and exposure to a laboratory-confirmed equine case) with Hendra virus infection. The procedure was performed without respiratory protection or gloves while the horse had a fever and respiratory distress. Endoscopic examination showed visible petechiae and ecchymoses in the respiratory tract. The veterinarian was given a five-day course of ribavirin from day 14 post exposure, but developed an influenza-like illness 21 days post exposure followed by encephalitis and death. Three other people with extensive exposure to the blood and respiratory secretions of the horse (and a second horse involved in the same outbreak and confirmed as having Hendra virus infection) remained well and did not seroconvert. These three people were also given ribavirin prophylaxis (1).

Details of Hendra virus incidents can be found at [Biosecurity Queensland](https://www.business.qld.gov.au/industry/agriculture/animal-management/horses/hendra-virus-owners) (https://www.business.qld.gov.au/industry/agriculture/animal-management/horses/hendra-virus-owners) The [New South Wales Department of Primary Industries](http://www.dpi.nsw.gov.au/content/agriculture/livestock/horses/health/general/hendra-virus) (http://www.dpi.nsw.gov.au/content/agriculture/livestock/horses/health/general/hendra-virus) and the [Department of Agriculture and Fisheries also provide information on Hendra virus incidents](https://www.daf.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus) (https://www.daf.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus).

Appendix 2: Fact Sheet: Hendra Virus Infection

Description

Hendra virus was discovered following an outbreak of illness in horses in a large racing stable in the suburb of Hendra, Brisbane, in 1994.

The natural host for Hendra virus is the flying fox. The virus can spread from flying foxes to horses, horses to horses and, rarely, from horses to people.

Since Hendra virus was identified in 1994, more than 90 horses are known to have been infected. These animals have either died as a direct result of their infection or have been euthanised.

Several hundred people have been exposed to Hendra virus-infected horses but have not been infected. However, seven people have been confirmed to have had Hendra virus infection following high levels of exposure to infected horses. Four of these people died, the most recent in 2009.

Evidence of exposure to Hendra virus has been identified in asymptomatic dogs on two occasions. These dogs were identified as contact animals on properties with infected horses. Research and testing of many other animals and insects has shown no evidence of Hendra virus infection occurring naturally in any other species.

Disease in humans

People infected with Hendra virus have become unwell with:

- an influenza-like illness with symptoms such as fever, cough, sore throat, headache and tiredness (which led to pneumonia in one case); and/or
- encephalitis (inflammation of the brain) with symptoms including headache, high fever and drowsiness, which progressed to convulsions and/or coma.

The time between exposure to a sick horse and the start of illness in humans has varied between 5 and 21 days.

Disease in horses

Hendra virus infection in horses may show itself in different ways and may be difficult to recognise. Early signs may include fever, increased heart rate and restlessness. Other common features include difficulty breathing and/or weakness and neurological signs such as uncoordinated gait and muscle twitching, quickly leading to death in most cases.

Transmission

While the exact route of infection is unknown, it is thought that horses may contract Hendra virus infection from sniffing or eating matter recently contaminated with flying fox urine, saliva or birth products. Spread of infection to other horses can then happen. Spread is possible wherever horses have close contact with body fluids of an infected horse. Small amounts of the virus may be present in a horse's body fluids, particularly nasal secretions, for a few days before they become sick.

The seven confirmed human cases all became infected following high-level exposures to respiratory secretions and/or blood of a horse infected with Hendra virus, following activities such as assisting with a post-mortem examination of a dead horse without adequate

personal protective equipment (PPE), performing certain veterinary procedures or having extensive exposure to respiratory secretions without adequate PPE. Other people have reported similar contact with infected horses but have remained well and their blood tests have shown no evidence of infection. No one with a lower-level exposure (e.g. grooming, feeding, patting), has ever developed Hendra virus infection or shown evidence of infection in blood tests.

There is no evidence of human-to-human transmission. People who have had contact with a person with Hendra virus infection, including health-care workers and their family members, have been tested and shown no evidence of infection with the virus.

There is no evidence that the virus can be passed directly from:

- flying foxes to humans;
- dogs to humans;
- the environment to humans, or
- humans to horses.

There is no evidence of airborne spread (where tiny particles remain suspended in the air).

Hendra virus is killed by heat, drying and cleaning with detergents.

Treatment

It is important that people who have been in close contact with a horse infected with Hendra virus, monitor their health. A person who becomes unwell in the weeks after close contact with an infected horse, should contact local public health authorities and seek medical advice promptly. Tests may be recommended in order to rule out Hendra virus infection as the cause of their illness. In most cases, a cause other than Hendra virus will be found. If Hendra virus infection develops, cases are managed supportively by a specialist medical and nursing team in hospital.

There is no known specific treatment for Hendra virus infection. To date, antiviral medications have not been effective, but three people have recovered from infections with general medical support.

People who have had high-level exposures to the body fluids of an infected horse may be offered experimental treatment with a type of antibody that may prevent infection.

Prevention

Preventing horse infection

A vaccine to prevent Hendra virus infection in horses has been available since November 2012. The Hendra virus vaccine was registered by the Australian Pesticide and Veterinary Medicines Authority (APVMA) on 4 August 2015. Further information can be found on the [APVMA website](http://apvma.gov.au/) (<http://apvma.gov.au/>) and in product information accompanying the vaccine. While the vaccine has been shown to be safe and to provide high levels of protection in horses, continued efforts to reduce exposure of horses to Hendra virus are essential.

It is important to:

- protect horse feed and water from contamination by flying fox fluids;
- isolate sick horses early while awaiting test results; and

- pay attention to standard hygiene and cleaning practices.

Further information is available through state and territory animal health authorities.

Preventing human infection

As a horse may be infectious with Hendra virus before becoming noticeably unwell, attention to standard hygiene practices is important when interacting with any horse. Horses should never be kissed on the muzzle. Hands must be washed with soap and water regularly after touching horses, particularly before eating, smoking or touching your eyes, nose or mouth. Wounds should be covered with a waterproof dressing. The use of PPE is recommended when a person is likely to be having contact with body fluids from any horse.

If a horse's body fluids or manure comes into contact with unprotected skin, the area should be washed with soap and water as soon as possible. If the exposure involves a cut or puncture wound, gently encourage bleeding and then wash the area with soap and water. Where water is not available, wipe the area clean, then use a waterless cleanser such as alcohol-based gel. If eyes are contaminated, rinse open eyes with clean water or normal saline for at least 30 seconds. If body fluids get in the mouth, spit the fluid out and then rinse the mouth with clean water several times.

If a horse becomes unwell and Hendra virus infection is suspected as a possibility, as few people as considered essential, should be involved in its care until the infection is ruled out. Children should be kept away from the horse. Appropriate PPE to prevent contamination of people's skin, eyes, nose or mouth from the horse's body fluids, should be worn when in close contact with the sick horse.

Although there is no evidence of human-to-human transmission, close contact with the body fluids of a person who is unwell with possible Hendra virus infection should be avoided. In hospitals, health-care workers will take routine precautions including the use of PPE. In home settings, pay attention to standard hygiene measures such as regular hand washing.

People exposed to Hendra virus should not donate blood or other body tissue until they are cleared of infection. Confirmed cases should never donate blood or any other tissue, even if they fully recover.

Notification

Suspected cases of Hendra virus infection in horses should be notified urgently to the relevant state or territory animal health authority.

Pathology laboratories are required to urgently notify public health of all requests for Hendra virus testing in humans.

Public health response

When a horse is strongly suspected or confirmed to be infected with Hendra virus, animal and public health authorities in each state and territory will take urgent measures to minimise risks to people and other animals (horses, dogs and cats).

Public health staff will seek to identify all people who may have been exposed to an infectious horse and will conduct detailed assessments of exposure levels.

People at risk of infection will be provided with information about Hendra virus and advised of appropriate ongoing monitoring and management.

Appendix 3: Information for people exposed to a horse infected with Hendra virus

This fact sheet is designed mainly for people who have been exposed to a horse infected with Hendra virus, but also contains information relevant to other people involved in a Hendra virus incident. It should be read in conjunction with the Hendra virus infection fact sheet.

Why am I being followed up?

You have been identified as someone who may have been close to a horse that has been confirmed to have Hendra virus infection. If you were near enough to get blood, respiratory secretions or other material from the horse on you, you will be interviewed to decide what level of 'exposure' you might have had.

Hendra virus is difficult to catch. Most people exposed to an infected horse are unlikely to become sick.

What does the follow-up involve?

Public health staff work with animal health authorities in each state and territory to identify people who may have been exposed to a horse infected with Hendra virus. This may involve talking to veterinarians, owners of the horse and property and people living on surrounding properties.

If you have been identified as being possibly exposed to an infected horse, public health unit staff will assess your level of exposure by asking detailed questions about when and how you interacted with the horse. They will also ask about any current illness or treatment.

People with any level of exposure to an infected horse are given information about Hendra virus. While public health staff will provide advice and support, people will also be advised to see their GP for ongoing support, as exposure to Hendra virus can be stressful.

If you are assessed as having had a high level of exposure to the body fluids of an infected horse, you will be referred to an infectious diseases specialist doctor for care.

What is the risk?

Most people exposed to a Hendra virus-infected horse stay well and do not contract the infection. Human infection with Hendra virus is rare.

In Australia, there have been seven confirmed human cases, the most recent occurring in 2009. Four of these people died. All seven became sick following high-level exposures to body fluids of an infected horse, such as:

- being extensively sprayed with respiratory secretions when not wearing appropriate PPE;
- conducting post-mortems on horses (cutting open the horse's body to determine the cause of death) without wearing PPE.

Some people have had high-level exposures to infected horses without wearing PPE, but remained well. People with lower-level exposures (e.g. grooming, feeding, patting), are not considered to be at significant risk. Hundreds of people have had lower-level exposures but none has ever developed Hendra virus infection.

Infected horses can possibly pass on the virus for a few days before they become sick, but they are most infectious after becoming sick.

Due to workplace health and safety requirements, animal health authority staff wear appropriate full-body PPE to work on properties that have infected horses. This does not mean that you are at any significant risk, especially if you had lower-level exposure.

What are the symptoms in humans?

Symptoms of Hendra virus infection in humans have developed between 5 and 21 days after exposure to an infectious horse (the incubation period).

The few people with Hendra virus infection in the past had either:

- an influenza-like illness with symptoms such as fever, cough, sore throat, headache and tiredness (which led to pneumonia in one case); and/or
- encephalitis (inflammation of the brain) with symptoms such as headache, high fever and drowsiness, which progressed to convulsions and/or coma.

What should I do if I become unwell?

If you develop symptoms such as those above, or any illness during the 21 days after your last exposure to an infected horse, you should seek medical advice quickly and call state or territory public health authorities. Public health staff may be able to help arrange medical assessment for you and provide advice to your doctor.

Any illness is much more likely to be due to something else, such as one of the many common viruses that cause colds or the 'flu.

You may need to be tested for Hendra virus infection, particularly if you had a high level of exposure.

Am I a risk to others?

If you have been exposed to a Hendra virus-infected horse but remain well, you are definitely not a risk to other people. You can continue to go to work or school and engage in all your usual activities.

There is no evidence that person-to-person spread of Hendra virus can occur – nobody has ever developed Hendra virus infection after exposure to an infected human.

If you do become unwell, you should take simple precautions, similar to those recommended for people with influenza, while you seek further medical advice:

- cover your mouth and nose when coughing or sneezing (or wear a surgical mask, if you have one);
- regularly wash your hands and dry them thoroughly;
- maintain a distance of at least one metre from other people where possible;
- ensure that anyone caring for you washes their hands regularly.

If you develop symptoms, health-care workers will take precautions and wear PPE, similar to that used for influenza patients, when caring for you.

You should not donate blood or any other body tissue until you have been cleared by public health authorities of any ongoing risk of Hendra virus infection.

Testing and diagnosis

If you are well

Testing for Hendra virus infection is only recommended if you have had a high-level exposure. If you have had a lower-level exposure and request testing, your request will be considered on a case-by-case basis.

If you are well and blood tests are performed on you following a Hendra virus exposure, a 'baseline' sample will be taken from you initially, with follow-up blood samples taken and tested at 21 days and 42 days after your last exposure. These tests look for antibodies to Hendra virus, which are substances that your body's immune system produces to help fight infections.

The first sample provides a baseline against which later tests are compared. The baseline test is expected to be negative if you are well, as it takes some days for infection to develop and for antibody tests to become positive. The baseline sample is not tested immediately, but is stored at the laboratory and examined at the same time as the second sample taken 21 days after exposure. This provides a more accurate comparison of the antibody levels in both samples. This is important, as it is possible with this type of antibody test to get what is called a 'false positive' result, meaning a positive result when you do not actually have the infection.

If you remain well, a negative result on the follow-up antibody test at 21 days after exposure will indicate it is highly unlikely that you have had Hendra virus infection. However, a final test at 42 days after exposure is taken as an extra precaution. No humans are known to have developed Hendra virus antibodies without becoming unwell.

If you need to be tested, collection of the blood samples will usually be arranged by the public health staff managing your assessment. Options for blood sample collection may include a local GP, pathology service, or hospital. If you have had a high-level exposure, testing will usually be arranged by the infectious diseases specialist you are referred to.

If you develop symptoms

Hendra virus infection in humans is rare. If you become unwell after exposure to an infectious horse, it will usually be due to something else. However testing for Hendra virus may be required, depending on your level of exposure and symptoms. Tests will be requested by your treating doctor and could include taking samples of blood and urine, and nose/throat swabs. Tests may also be done for other more common viruses such as influenza.

These samples will be examined for genetic material of Hendra virus (nucleic acid testing). A negative result to this type of test will confirm that Hendra virus is not the cause of your symptoms, while a positive result would reliably confirm Hendra virus infection.

Further information about the testing process is available from your state or territory public health authority.

How is it treated?

There is currently no specific treatment for Hendra virus infection in humans.

People who have had a high-level exposure to the body fluids of an infected horse may be offered experimental treatment with monoclonal antibodies.

Monoclonal antibodies against Hendra virus are a type of antibody developed in research laboratories to try to prevent or reduce the severity of Hendra virus infection. These antibodies have only been given to a small number of people who were at significant risk of contracting infection. Their use is currently experimental and further research is needed to determine their safety. At present, only people with high-level exposure are considered for this treatment. If you are offered monoclonal antibodies, you will be provided with medical counselling regarding possible risks and benefits.

Dealing with concerns

Exposure to Hendra virus may be stressful for you and your family. If you feel worried or concerned, it is good to talk over your concerns with your GP or your local public health unit staff.

Alternatively, counselling services may be available in your state or territory and access to counselling can be discussed with local public health staff.

Support for veterinarians is also available from the [Australian Veterinary Association](http://www.australianveterinaryassociation.com.au):

Web: www.ava.com.au

Tel: 1800 337 068.

Media

Hendra virus incidents often attract media interest. While the identity of people involved is not disclosed by government agencies, the media often becomes aware of the location due to activities required to prevent further risk of infection, such as:

- signs erected at quarantined properties by animal health agencies;
- government media announcements meant to reassure the public that appropriate responses are in place;
- door knocking of adjoining properties by government agency staff.

For advice and support to manage unwelcome media attention, please call public health in your state or territory. Public health staff will liaise with local media and can assist with managing media enquiries.

Appendix 4: Hendra virus infection information for Health-care Workers

Description

Hendra virus infection is a disease caused by Hendra virus. Initially named equine morbillivirus, Hendra virus is a member of the genus *Henipavirus*, a new class of virus in the *Paramyxoviridae* family. Closely related to Nipah virus, it was first isolated in 1994 during an outbreak of acute respiratory disease among horses and humans in Hendra, Brisbane.

The virus can spread from its natural host (the flying fox), to horses, horses to horses, and rarely, from horses to people. Evidence of exposure to Hendra virus has been identified in asymptomatic dogs on two occasions. These dogs were identified as contact animals on properties with infected horses.

Symptoms

Disease in Humans

People infected with Hendra virus have become unwell with:

- an influenza-like illness with symptoms such as fever, cough, sore throat, headache and tiredness (which led to pneumonia in one case); and/or
- encephalitis (inflammation of the brain) with symptoms including headache, high fever and drowsiness, progressing to convulsions and/or coma.

The time between exposure to a sick horse and the start of illness in humans has varied between 5 and 21 days.

Transmission

While the exact route of infection is unknown, it is thought that horses may initially contract Hendra virus infection from sniffing or eating matter recently contaminated with flying fox urine, saliva or birth products. The spread of infection to other horses can then occur.

The seven confirmed human cases all became infected from high-level exposures to respiratory secretions and/or blood of a horse infected with Hendra virus, such as via assisting with the post-mortem examination of a dead horse without: appropriate PPE; performing certain veterinary procedures; or having extensive exposure to respiratory secretions without appropriate PPE.

There is no evidence of human-to-human transmission. Tests conducted on people who have had contact with a person with Hendra virus infection, including health-care workers and family members, have shown no evidence of the virus. There is no evidence that the virus can be passed directly from: flying foxes to humans; dogs to humans; the environment to humans; or humans to horses. There is no evidence of airborne transmission.

Hendra virus is killed by heat, drying and cleaning with detergents.

Treatment

There is no known specific treatment for Hendra virus infection. To date, antiviral medications have not been effective, but three people have recovered from infections with general medical supportive care.

People who have had high-level exposures to the body fluids of an infected horse may be offered experimental treatment with a human monoclonal antibody that may prevent infection.

Infection Prevention and Control

Community

There is no vaccine for humans against Hendra virus. A vaccine for horses which has been available through accredited veterinarians since November 2012, was registered by the Australian Pesticide and Veterinary Medicines Authority (APVMA) on 4 August 2015. For further information see: (<http://apvma.gov.au/>) and/or product information accompanying the vaccine.

If a horse becomes unwell and Hendra virus infection is suspected, as few people as possible should be involved in its care until the likelihood of infection is ruled out. Appropriate PPE which prevents contamination of the skin, eyes, nose or mouth by the horse's body fluids should be worn by people in close contact with the sick horse. After contact with a sick horse, hand hygiene and environmental cleaning measures should be undertaken.

Health-care Workers

There is no evidence of human-to-human transmission of the virus. However, contact and droplet transmission-based precautions should be applied when providing direct patient care to symptomatic persons suspected or known to be infected with Hendra virus. Airborne precautions should also be implemented during aerosol-generating procedures.

Asymptomatic contacts of an infected animal or human should be managed using standard precautions.

Additional transmission-based precautions may be ordered at the discretion of the treating infectious diseases specialist.

Testing

Human testing may be indicated when there:

- has been significant exposure to confirmed or suspected equine cases; or
- is an indication of human illness, in which case testing is performed after consultation with an infectious diseases physician.

Testing is available at Queensland Health Forensic and Scientific Services.

Nucleic acid testing can be performed on serum (preferable to blood), respiratory samples (deep nasal swab or nasopharyngeal aspirate), cerebrospinal fluid, urine and tissue samples. Minimum volume for liquid samples is 0.5ml.

Serology is performed using a screening microsphere immunoassay for IgM and IgG. If positive, this is followed up by a confirmatory immunofluorescence assay that can be quantified. False positive results can occur.

The earliest laboratory evidence of infection in human Hendra virus cases has been positive nucleic acid testing in blood, respiratory specimens, then urine, with serology becoming positive two-five days after onset of symptoms.

For most human contacts of an equine case, blood tests are not routinely recommended unless the person has had significant exposure. Serum is taken at baseline to be stored and tested in parallel with samples taken three and six weeks after exposure.

For suspected human cases, a dedicated sample of serum should be taken for NAT and a further sample for serology.

For Further Information

[Australian Government:](#)

(<http://www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-hendra.htm>)

Other fact sheets:

Information for people exposed to a horse infected with Hendra virus
(<http://www.health.qld.gov.au/cdcg/documents/hendra-contact-fs.pdf>)

[Hendra Virus Infection](#)

(<http://conditions.health.qld.gov.au/HealthConditions/2/Infections-Parasites/41/Viral-Infections/288/Hendra-Virus-Infection>)

Hendra Virus Infection Prevention Advice

(<http://www.health.qld.gov.au/ph/documents/cdb/hev-inf-prev-adv.pdf>)

[Primary Industry Resources](#)

(<https://www.health.qld.gov.au/industry/primaryir/default.asp#hendra>)

References

[CSIRO. Hendra Virus](#) [Internet]. 2012 [cited 2013 Aug 30].

(<http://www.csiro.au/Outcomes/Food-and-Agriculture/Hendra-Virus.aspx>)

[World Health Organization. Hendra Virus](#) [Internet].

(<http://www.who.int/csr/disease/hendra/en/>)

[NSW Department of Primary Industries. Hendra Virus Vaccine](#) [Internet]. 2013 [cited 2013 Aug 30].

(<http://www.dpi.nsw.gov.au/agriculture/livestock/horses/health/general/hendra-virus>)

Department of Agriculture, Fisheries and Forestry. [Information for horse industries and owners](#) (<https://www.daff.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus/horse-industries-owners>)

Department of Justice and Attorney General, Workplace Health and Safety Queensland.

Hendra virus – information for horse properties and other horse businesses.

(https://www.worksafe.qld.gov.au/__data/assets/pdf_file/0009/82989/alert-hendra_virus_horse.pdf)

Appendix 5: Exposure assessment form

[Hendra virus exposure assessment form](#) can be accessed via the Hendra Virus SoNG webpage (www.health.gov.au/internet/main/publishing.nsf/Content/cdna-song-hendra.htm).

(This page contains form/s that are intended to be paper based that you can download and complete. If you are using any assistive technology and are unable to use the form please contact us using the [Online form](#) and feedback)

Appendix 6: Public health checklist

Public Health Unit (PHU) Incident Management Checklist for confirmed equine case of Hendra virus infection, or where state or territory animal health authority advises of heightened suspicion.

Contact relevant state/territory animal health authority to:

- Clarify timeline for results of laboratory testing, if not already confirmed;
- Ensure appropriate infection-control measures are in place;
- Identify potential contacts and establish whether/what communication has occurred.

Contact potential contacts to:

- Assess horse exposure/s using Exposure assessment form/s
 - If high exposure to body fluids of a confirmed equine case, liaise with an infectious diseases physician as soon as practicable regarding PEP
 - If medium exposure, discuss as soon as practicable with appropriately-experienced public health practitioners and infectious diseases physician/s to reach consensus on exposure assessment.
- Assess current health status
- Refer any symptomatic people to appropriate care
- Counsel about risk
- Advise about laboratory testing recommendations
- Provide Hendra Factsheet for contacts
- Advise about self-monitoring of their health and to seek early medical advice if they develop fever or respiratory or neurological symptoms within 3 weeks of exposure
- Advise them to access their usual health-care practitioner to assess need for ongoing physical and psychological support, medical or workers compensation certification and referral to other services as necessary
- Assess tetanus vaccination history.

Other issues:

- Maintain communication with state or territory central state or territory communicable diseases agency
- Establish a team to manage public health response if confirmed equine case
- Involve state or territory workplace health and safety authority if confirmed transmission has occurred in a workplace.

PHU Case Checklist for suspected or confirmed human case of Hendra virus infection

Case Name and ID number:

For all suspected or confirmed human cases

Contact the case's doctor to:

- Obtain case's history
- Confirm results of relevant pathology tests or recommend relevant tests be done
- Ensure appropriate infection control measures are in place.

If confirmed or heightened suspicion on clinical and epidemiological grounds

Contact the case's doctor to:

- Ensure liaison with an infectious diseases physician occurs
- Seek contact details for case or carer.

Contact the case or carer to:

- Confirm onset date and symptoms of the illness
- Identify any exposures to known equine cases, and other equine exposures where relevant
- Assess equine exposure/s using exposure assessment form, where relevant
- Identify contacts and obtain contact details
- Provide advice, including on recommended restrictions, and Hendra factsheet.

Liaise with relevant state/territory animal health authority to:

- Alert to case
- Discuss need for testing of relevant horses, where appropriate.

If confirmed human case, contact case's contacts to:

- Assess exposure
- Provide advice and Hendra Factsheet for contacts.

Other issues:

- Maintain communication with central state or territory communicable diseases agency
- Establish a team to manage public-health response if confirmed human case

- Involve state or territory workplace health and safety authority if confirmed transmission has occurred in a workplace
- In states and territories where Hendra virus infection is notifiable, enter case data onto notifiable diseases database.