

Hendra virus

NSW Control Guideline for Public Health Units

Revision History

Revision history			
Version	Date	Revised by	Changes
1.0	4 Nov 2010	-	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.
2.0	10 April 2017	Communicable Diseases Branch	Update for consistency with the Hendra Series of National Guidelines (SoNG) v3.0 (endorsed 1 March 2017, released 15 March 2017), localised for NSW as indicated by [hard brackets]. Updated sections of the disease, laboratory testing, vaccination in horses and exposure assessment tool.

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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 [the NSW Department of Primary Industries (DPI)].
- 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 [NSW DPI] is necessary – joint meetings should be held with [NSW DPI] 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.

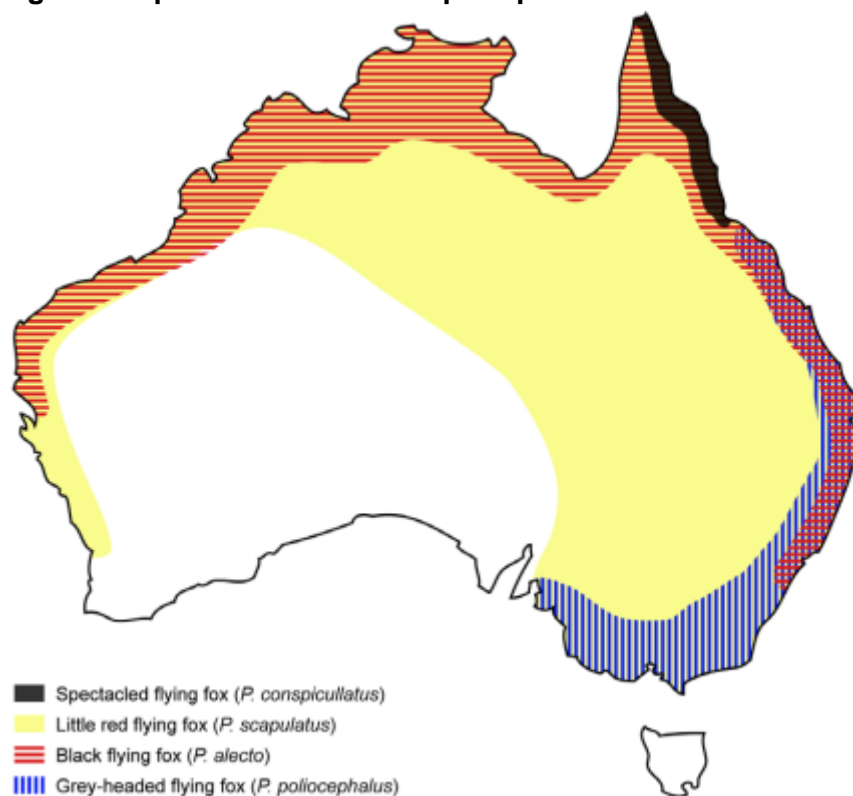
Reservoir

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 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>).

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.

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 4: 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): (<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 [NSW DPI]. 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

Confirmed human cases should be entered onto the [Notifiable Conditions Information Management System (NCIMS)], 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 [NSW Communicable Diseases Branch (CDB)].
- As soon as practicable and ideally within four hours of notification, the [NSW CDB] should notify [NSW DPI] of any confirmed human case.
- As soon as practicable, and ideally within one working day, the [NSW CDB] 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 [NSW DPI].

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 [NSW DPI] 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 [NSW DPI] 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 [NSW DPI] is necessary and regular interagency meetings should be held to ensure a coordinated response. [SafeWork NSW] 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 [NSW DPI] 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 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 [NSW DPI] 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 [NSW DPI].

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 [NSW DPI]. 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 [NSW DPI] 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 [NSW DPI] 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 4: 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]); [and] Appendix 3: [NSW Fact Sheet:] Information for people exposed to a horse infected with Hendra virus).

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 [NSW DPI] or determined by the relevant public health unit.

If an equine case is confirmed, it may be appropriate for [Public Health Unit officials] 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 [NSW DPI] 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

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14. Appendices

Appendix 1: Summary of human cases of Hendra virus infection

Appendix 2: [NSW Fact Sheet:] Hendra Virus Infection

Appendix 3: [NSW Fact Sheet:] Information for people exposed to a horse infected with Hendra virus

Appendix 4: Exposure assessment form

Appendix 5: Public health checklist

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: [NSW Fact Sheet:] Hendra Virus Infection

Hendra virus is a virus that mainly infects large fruit bats (flying foxes) which can be passed on to horses. The infection has occasionally been passed onto people who have been in close contact with an infected horse.

Last updated: 10 April 2017

What is Hendra virus?

- Hendra virus is a virus that infects large fruit bats (flying foxes).
- Occasionally the virus can spread from flying foxes to horses and horses can then pass the infection on to humans. A small number of people who have had very close contact with infected horses have developed Hendra virus infection.
- A single dog showed evidence of exposure to Hendra virus on a property where three horses developed infection in July 2011.
- There is no evidence of Hendra virus occurring naturally in any other species.
- Hendra virus was discovered following an outbreak of illness in a large racing stable in the suburb of Hendra, Brisbane in 1994.

What are the symptoms?

Hendra virus symptoms in horses

- Hendra virus can cause a range of signs in horses. Usually there is a rapid onset of illness, fever, increased heart rate and rapid deterioration with respiratory and/or neurological (nervous system) signs. For more information on Hendra virus infection in horses, refer to the NSW Department of Primary Industries (DPI) website at www.dpi.nsw.gov.au.

Hendra virus signs and symptoms in people

- Symptoms typically develop between 5 and 21 days after contact with an infectious horse.
- Fever, cough, sore throat, headache and tiredness are common initial symptoms. Meningitis or encephalitis (inflammation of the brain) can develop, causing headache, high fever, and drowsiness, and sometimes convulsions and coma.
- Hendra virus infection can be fatal.

How is it spread?

- It is thought that horses may contract Hendra virus infection from eating food recently contaminated by flying fox urine, saliva or birth products.
- The spread of Hendra virus between horses is possible whenever horses have close contact with body fluids from an infected horse.
- All confirmed human cases to date became infected following high level exposures to body fluids of an infected horse, such as doing autopsies on horses without wearing appropriate personal protective equipment, or being extensively sprayed with respiratory secretions.
- There is no evidence of human to human, bat to human, bat to dog, or dog to human transmission.

Who is at risk?

People who have had close contact (particularly high level exposures as described above) with an infected horse, without wearing appropriate personal protective equipment, are most at risk.

How is it prevented?

Preventing horse infection

- Protect horse feed from contamination by flying fox fluids.
- Contact your local veterinarian if you notice unusual disease symptoms, abnormal behaviour or unexpected deaths in your horses. If you cannot contact your veterinarian, contact the NSW Department of Primary Industries or the Emergency Animal Disease Watch Hotline on 1800 675 888 (24-hour hotline).
- Isolate sick horses from other horses.
- A vaccine for horses is available and vaccination of horses is strongly encouraged and horse owners should discuss vaccination with their veterinarian..

Preventing human infection

- While the greatest risk is with sick horses, infected horses can shed Hendra virus for a few days before they show any sign of illness so it is always important to use good hygiene practices when around horses.
- Don't kiss horses on the muzzle (especially if the horse is sick).
- Cover any cuts or abrasions on exposed skin with a waterproof dressing before handling horses and wash your hands well with soap and water, especially after handling your horse's mouth or nose (e.g. fitting or removing a bridle) and before eating, smoking or touching your eyes, nose or mouth.
- If body fluids or manure from a horse gets on unprotected skin the area should be washed with soap and water as soon as possible.
- If a horse becomes unwell and Hendra virus infection may be a possibility, as few people as possible should care for the horse until the infection is ruled out.
- Appropriate personal protective equipment which prevents contamination of the skin, eyes, nose and mouth by the horse's body fluids should be worn if close contact with the sick horse is considered essential.
- Although there is no evidence of Hendra virus spreading from an infected person to another person or animal, health care workers will take a cautious approach and wear personal protective equipment when caring for people suspected or confirmed to be infected.
- If you have been exposed to Hendra virus, you should not donate blood or any other tissue until you are cleared of infection. Confirmed cases should never donate blood or any other tissue, even if they fully recover.
- No human vaccine is currently available.

How is it diagnosed?

People with suspected Hendra virus infection will usually have blood and urine tests. Depending on their symptoms they may also have nose/throat swabs and/or other tests.

People with high level exposures to horse body fluids may have blood samples collected over six weeks to check if they have developed antibodies to the infection. Testing for Hendra virus infection is generally not recommended for people who had had lower-level exposure.

How is it treated?

There is no specific treatment for Hendra virus infection and cases are treated supportively in hospital or in intensive care. Antiviral medications have not been found to be effective in treating Hendra virus infection. People who have had high exposures to the body fluids of an infected horse may be offered experimental treatment with a type of antibody that may prevent infection.

What is the public health response?

- When a horse is diagnosed with Hendra virus infection, the local public health unit will work closely with the NSW Department of Primary Industries, horse and property owners, and veterinarians to identify people who may have been exposed.
- Public health unit staff will identify people who may be at risk and contact them to assess their exposure.
- People who may be at risk of infection will be given information about Hendra virus and asked to monitor their health. Where necessary, arrangements will be made for blood tests to be taken.

For further information on Hendra virus in humans

[Qld health website](#)

For further information on Hendra virus in horses

[Biosecurity Queensland](#)

[NSW Department of Primary Industries](#)

Further information

- [Information for people who are being monitored for Hendra virus infection](#)
- [Response Protocol for contacts with moderate or high-level exposure \(NSW Health Staff Only\)](#)
- [Laboratory testing protocols](#)

Appendix 3: [NSW Fact Sheet:] Information for people exposed to a horse infected with Hendra virus

This fact sheet is specifically for people who have been exposed to a horse or human infected with Hendra virus. Please read the general Hendra virus fact sheet first.

Last updated: 10 April 2017

Why am I being followed up?

- You have been identified as someone who has had contact with a horse or human that has been confirmed to have Hendra virus infection.

What is the risk?

- Several hundred people have been exposed to Hendra virus infected horses and tested for infection - only a few of these people (seven as of October 2011) have become sick and no one has ever had a 'silent' infection without symptoms.
- The small number of people who have contracted Hendra virus infection all became sick following high level exposures to body fluids of an infected horse, such as doing autopsies on horses without wearing appropriate personal protective equipment, or being extensively sprayed with respiratory secretions.
- Many people have reported high level exposures to infected horses but have remained well.
- People are at some risk if they have had exposure to an infected horse's body fluids and appropriate personal protective equipment, including gloves and a mask, was not worn.
- People with high level exposures to infected horses are most at risk - no one with a lower level exposure has ever developed Hendra virus infection.
- Affected horses are thought to be potentially infectious to humans for a few days before they become sick but are most infectious after they become sick.
- No one has ever developed Hendra virus infection after exposure to an infected human.

What is the follow up?

- Public health unit staff identify people who may be at risk and contact them to assess their exposure.
- People who may be at risk of infection are given information about Hendra virus and asked to monitor their health.
- Blood tests are not routinely required following most exposures to horses or humans with Hendra virus infection, but arrangements will be made for testing where appropriate.
- People who have had high exposures to the body fluids of an infected horse may be offered testing and experimental treatment with a type of antibody that may prevent infection.

What if I get symptoms?

- Symptoms of Hendra virus infection in humans typically develop between 5 and 21 days after contact with an infectious horse.
- If you become unwell during this time you should seek medical advice promptly.
- Fever, cough, sore throat, headache and tiredness are common initial symptoms.
- Meningitis or encephalitis (inflammation of the brain) can develop.
- Symptoms of encephalitis include headache, high fever, and drowsiness, and sometimes convulsions and coma.

- Although there is no evidence of Hendra virus spreading from an infected person to another person, health care workers will take a cautious approach and wear personal protective equipment when caring for people suspected or confirmed to be infected.

Am I at risk to others?

- Providing you remain well, you are not at risk to other people and you are not restricted from doing anything or going anywhere while you are in the monitoring period.
- If you are being monitored for developing Hendra virus, you should not donate blood or any other tissue until the third set of blood tests (day 42) show that you have not developed Hendra virus antibodies.
- If you have recovered from Hendra virus infection, you should never donate blood or any other tissue.

How is it diagnosed?

- People with symptoms of suspected Hendra virus infection will usually have blood and urine tests. Depending on their symptoms they may also have nose/throat swabs and/or other tests.
- Testing for Hendra virus infection is only recommended for people who have had a high-level exposure.

How is it treated?

- There is no specific treatment for Hendra virus infection and cases are treated supportively in hospital or in intensive care.
- Antiviral medications have not been found to be effective in treating Hendra virus infection.
- Antibodies against Hendra virus have been used to treat people with the infection, but this treatment remains experimental.

Mental health

This experience may be stressful for you and your family. If you feel worried or concerned it's a good idea to talk over your concerns with your GP.

Support for veterinarians is also available from the [Australian Veterinary Association](#).

Am I at risk to others?

- As a precaution you should not donate blood or any other tissue until you are cleared of infection.
- Whilst you remain well, you are not a risk to other people and you are not restricted from your usual activities.

For further information please call your local Public Health Unit on 1300 066 055

Appendix 4: 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).

Appendix 5: Public health checklists

Public Health Unit (PHU) Incident Management Checklist for confirmed equine case of Hendra virus infection, or where [NSW Department of Primary Industries (DPI)] advises of heightened suspicion.

Contact [NSW DPI] 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

Other issues:

- Maintain communication with [NSW Communicable Diseases Branch]
- Establish a team to manage public health response if confirmed equine case
- Involve [SafeWork NSW] if confirmed transmission has occurred in a workplace.

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

[NCIMS ID]:

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 [NSW Department of Primary Industries] 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 [NSW Communicable Diseases Branch]
- Establish a team to manage public-health response if confirmed human case
- Involve [SafeWork NSW] if confirmed transmission has occurred in a workplace
- [E]nter case data onto [the Notifiable Conditions Information Management System (NCIMS)].