

AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Response strategy

Hendra virus

Version 5.0

AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

National Biosecurity Committee

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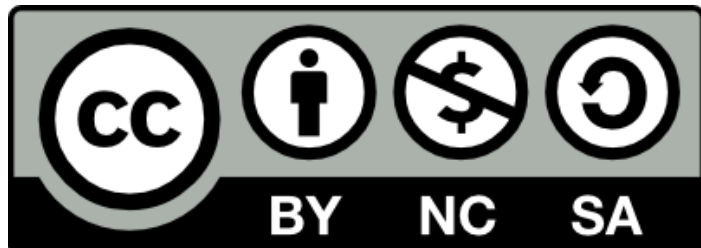
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DISEASE WATCH HOTLINE: 1800 675 888

The Disease Watch Hotline is a toll-free telephone number that connects callers to the relevant state or territory officer to report concerns about any potential emergency disease situation. Anyone suspecting an emergency disease outbreak should use this number to get immediate advice and assistance.

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1 Introduction

1.1 This manual

1.1.1 Purpose

As part of AUSVETPLAN (the Australian Veterinary Emergency Plan), this response strategy contains the nationally agreed approach for the response to an incident – or suspected incident – of Hendra virus in Australia. It has been developed to guide decision making to ensure that a fast, efficient and effective response can be implemented consistently across Australia with minimal delay.

1.1.2 Scope

This response strategy covers Hendra caused by Hendra virus.

This response strategy provides information about:

- the disease (Section 2)
- the agreed policy and guidelines for agencies and organisations involved in a response to an outbreak (Section 3)

1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak of Hendra are based on risk assessment.

This manual has been produced in accordance with the procedures described in the **AUSVETPLAN Overview**, and in consultation with Australian national, state and territory governments; the relevant livestock industries; nongovernment agencies; and public health authorities, where relevant.

In this manual, text placed in square brackets [xxx] indicates that that aspect of the manual remains unresolved or is under development; such text is not part of the official manual. The issues will be worked on by experts and relevant text included at a future date.

1.2 Other documentation

This response strategy should be read and implemented in conjunction with:

- other AUSVETPLAN documents, including the operational, enterprise and management manuals; and any relevant guidance and resource documents. The complete series of manuals is available on the Animal Health Australia website¹
- relevant nationally agreed standard operating procedures (NASOPs).² These procedures complement AUSVETPLAN and describe in detail specific actions undertaken during a

¹ www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents

² www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/nationally-agreed-standard-operating-procedures

response to an incident. NASOPs have been developed for use by jurisdictions during responses to emergency animal disease (EAD) incidents and emergencies

- relevant jurisdictional or industry policies, response plans, standard operating procedures and work instructions
- relevant Commonwealth and jurisdictional legislation and legal agreements (such as the Emergency Animal Disease Response Agreement – EADRA³), where applicable.

1.3 Training resources

EAD preparedness and response arrangements in Australia

The EAD Foundation online course⁴ provides livestock producers, veterinarians, veterinary students, government personnel and emergency workers with foundation knowledge for further training in EAD preparedness and response in Australia.

³ <https://animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement>

⁴ www.animalhealthaustralia.com.au/emergency-animal-disease-training-program

2 Nature of the disease

Hendra virus (HeV) is a zoonotic pathogen that has caused natural infection and disease in horses and humans. Humans have presumably been infected as 'spillover' events from infected horses.

There is no effective treatment for infected animals and no specific treatment for HeV infection in humans, although the administration of monoclonal antibody 102.4 is being studied in a phase 1 human clinical trial (Broder et al 2016).

2.1 Aetiology

HeV is in the *Henipavirus* genus of the *Paramyxoviridae* family. This genus contains Hendra, Cedar and Nipah viruses.

2.2 Susceptible species

Pteropid bats (flying foxes) are the known natural reservoir host of HeV infection; seroprevalence varies between 20% and 50%. Sporadic spillover of HeV from flying foxes to horses occurs; however, the factors associated with spillover events are not yet fully understood, and research is ongoing (Field et al 2015, Plowright et al 2015). Neutralising antibodies to the virus are found in flying fox populations in Australia and Papua New Guinea.

Horses are the only species known to have been infected naturally from flying foxes.

Humans have become infected only after close contact with respiratory or oral secretions, body fluids or blood from an infected horse. No human is known to have been infected through direct contact with flying foxes. To October 2015, seven people had been infected after close contact with HeV-infected horses. Four of these people subsequently died of their infection.

In July 2011 and July 2013, HeV antibodies were detected in two dogs sampled on premises where HeV had been confirmed in horses. The dog in July 2013 also tested positive by quantitative reverse transcription polymerase chain reaction (PCR) testing on antemortem blood samples (EDTA and serum) and postmortem on several tissue samples (Kirkland et al 2015). Neither dog showed any clinical signs of illness. The dogs potentially had multiple opportunities for contact with infected horses or their discharges, and this is the most plausible route of infection.

Experimental studies by Middleton (2016b) showed that dogs could be reliably infected with HeV and showed either very mild, transient clinical signs or no clinical signs. HeV was recovered from the oral cavity of acutely infected dogs, and the secretions were capable of transmitting HeV to naive ferrets. Development of neutralising antibody was associated with virus clearance; this has also been noted in cats, horses and ferrets.

Experimental research on other animal species has found that cats, pigs, hamsters, ferrets, African green monkeys, guinea pigs and mice can be infected with HeV and develop clinical signs (Westbury et al 1995, Bossart et al 2011, Pallister et al 2011, Dups et al 2012). Rats and rabbits developed antibodies but not clinical signs when exposed to HeV (Westbury et al 1995).

Experimental studies in Canada (Li et al 2010) showed that the response of pigs to inoculation with large doses of HeV ranged from no clinical disease to severe interstitial pneumonia. Although this work has demonstrated that pigs can be infected experimentally, no natural infections have been

detected in pigs. A targeted serological survey of commercial piggeries in Queensland found no evidence of antibodies to HeV (Black et al 2001).

2.3 Distribution

All confirmed HeV infections in horses have overlapped with the spatial distribution of pteropid bats (*Pteropus* species; see Figure 2.1). Since the spatial distribution of pteropid bats may change from year to year and from season to season, Figure 2.1 is indicative only.

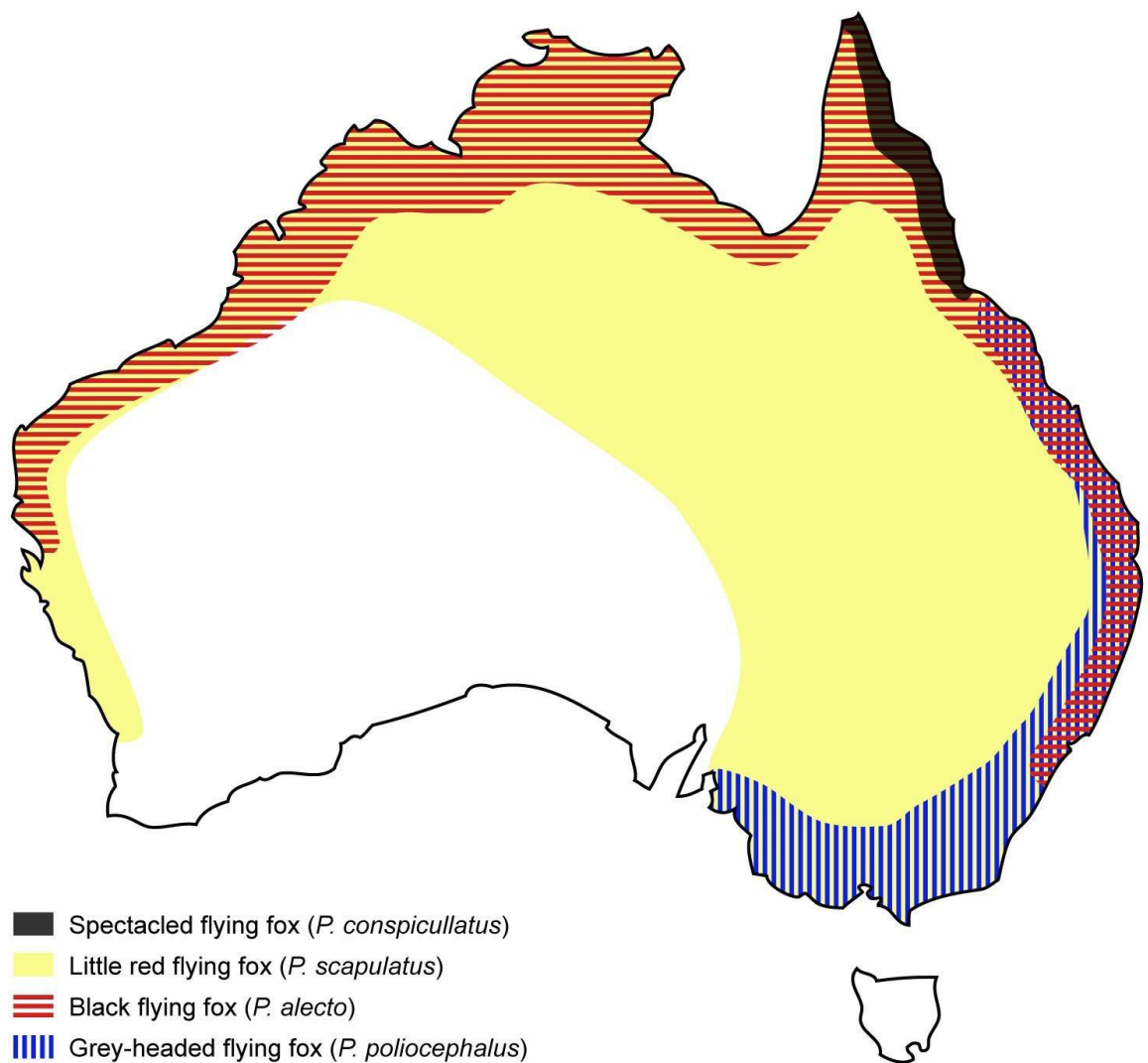


Figure 2.1 Spatial distribution of pteropid bats in Australia, 2012

Field et al (2011) showed that the prevalence of HeV excretion in flying foxes varied significantly between years, providing a biologically plausible basis for the variable annual case frequency in horses.

The key spatial and temporal factors associated with HeV excretion in flying foxes were investigated in a landmark 3-year multiroost study (Field et al 2015) . Almost 14 000 pooled urine samples were collected from 50 roosts between Cairns in northern Queensland and Batemans Bay in southern New South Wales (a distance of 2300 km). The study found that mean HeV prevalence varied spatially being highest in northern New South Wales and southern Queensland, and moderate in northern Queensland. The variation in excretion prevalence was more consistent with species distribution than latitude; specifically, excretion prevalence paralleled the distribution of black flying foxes (*Pteropus alecto*) and, in north Queensland, spectacled flying foxes (*P. conspiculatus*). The lowest mean excretion prevalence was found in southern New South Wales, reflecting the near absence of black flying foxes and the dominance of grey-headed flying foxes (*P. poliocephalus*). The study findings are consistent with several recent studies that indicate that black and spectacled flying foxes are the primary reservoir host species for HeV (Smith et al 2014, Edson et al 2015ab, Goldspink et al 2015).

A strong winter peak of excretion was also found in central and northern New South Wales, and southern Queensland, consistent with the observed temporal pattern of HeV spillover events in these regions.

Statistics on HeV spillover events, such as dates, locations and species, can be found on the Queensland Department of Agriculture and Fisheries website⁵

2.4 Diagnostic criteria

2.4.1 Case definition

The case definition of an HeV-infected animal is:

- an animal (with or without clinical signs) that tests positive to HeV using one or more of the following tests
 - polymerase chain reaction (PCR)
 - virus isolation
 - immunohistochemistry, or
- an animal for which testing has not been possible or for which testing is inconclusive, but scientific evidence (clinical, laboratory, epidemiological) that the animal is/was infected is compelling (eg confirmed human infection following contact with an animal with clinical signs and history suggestive of HeV infection). Such status decisions are made by the jurisdictional chief veterinary officer (CVO).

Confidence in a PCR test result is increased by testing of multiple samples of different types. A single negative result on a single sample may be a false negative as a result of insufficient diagnostic material or low levels of RNA at the sampled site.

The case definition of an HeV-recovered animal is an animal:

- free from clinical signs suggestive of HeV infection, and
- PCR negative and with a detectable serum antibody response not consistent with its vaccination history, or

⁵ www.agriculture.gov.au/pests-diseases-weeds/animal#hendra-virus

- for which testing has not been possible or for which testing is inconclusive but scientific evidence (clinical, laboratory, epidemiological) that the animal was infected and no longer poses a transmission risk is compelling, in the opinion of the CVO.

The case definition of an HeV-vaccinated animal is an animal that has:

- a current vaccination status (ie evidence of vaccination following the recommended schedule), and/or
- an antibody response that is consistent with its known HeV vaccination status.

It is possible for an animal to be both antibody and PCR positive if sampled early in recovery. Although such results most likely reflect remnant RNA rather than viable virus, the PCR testing should be repeated until a negative result is obtained.

Where positive PCR results are obtained from nonclinical animals sampled at anatomical sites that are susceptible to environmental contamination (eg nasal cavity, oral cavity, rectum), or from samples where contamination cannot reasonably be excluded, confirmation that the animal was infected, to support the diagnosis of an HeV-recovered animal, may require demonstration of an antibody response.

Any vaccinated animal or recovered animal that also meets the criteria for an HeV-infected animal will be considered to be an HeV-infected animal, regardless of its circulating antibody level.

2.4.2 Clinical signs and pathology

HeV infection in flying foxes is not associated with clinical disease.

HeV infection in horses typically causes an acute illness that is rapidly fatal. There are no pathognomonic clinical signs. Horses infected with HeV have shown variable and often vague clinical signs, including respiratory and/or neurological signs, frequently accompanied by pyrexia.

In most of the recorded cases of infection, there has been strong presentation of neurological or respiratory clinical signs; however, occasional cases have had a much milder presentation. From the disease pathogenesis perspective, it is reasonable to assume that virus-induced damage to vascular endothelium and the subsequent vasculitis play a major role in producing clinical signs, and that the clinical presentation relates to the organ system(s) sustaining severe and compromising endothelial damage.

Laboratory analysis has shown that an infected horse showing clinical signs will have virus in blood and tissues, and may be excreting HeV in body fluids and excretions, including urine, oral and nasopharyngeal secretions, and faeces. In one naturally infected dog, pathological lesions of systemic vasculitis were identified in many organs, with brain, kidney, liver, and tracheobronchial and bronchial lymph nodes most affected. Very low levels of RNA were detected by PCR in a wide range of organs; higher levels were detected in kidney, liver, spleen, spinal cord and some lymph nodes.

There is little information on survival rates for acutely infected horses. In one spillover event, 20% ($n = 5$) of infected horses survived acute infection (Field et al 2010).

In experimentally infected cats, guinea pigs, pigs, hamsters, African green monkeys and ferrets, infection was comparable to that seen in naturally and experimentally infected horses. Cats demonstrate inappetence and increased respiratory rate, followed by death within 1–2 days (Westbury et al 1995). Ferrets demonstrate severe respiratory and neurological disease, as well as generalised vasculitis (Pallister et al 2011).

Either no clinical signs or very mild, transient clinical signs, including scleral injection, have been reported in dogs (Middleton 2016b). It is unlikely that a dog acutely infected with HeV would come to the attention of the owner or veterinarian.

2.4.3 Laboratory tests

Specimens required

A wide range of relevant specimens will:

- increase the overall diagnostic sensitivity, particularly if viral genome is at or near the limits of detection
- provide more information about the state of infection, and the potential for virus excretion and transmission to others from an individual HeV-positive animal
- increase the confidence in a negative HeV diagnosis (specificity), if a wider range of negative results are obtained from the same animal.

Preferred specimens to allow or rule out a diagnosis of an acute case are as follows:

- **EDTA blood** used for PCR and virus isolation. Note that the tube should be properly filled to minimise the risk of a high anticoagulant concentration interfering with testing.
- **Swabs.** Nasal, oral or rectal swabs may be used for PCR testing and virus isolation, and may detect infection at an earlier stage of infection than blood or other clinical specimens (eg body fluids and secretions). A urine-soaked swab taken from the ground immediately after urination may also be used for PCR and virus isolation.
- **Serum** (plain/clotted whole blood). If only serum is available, it can be used for both PCR and serology. However, it is not the preferred specimen for PCR because of its lower sensitivity. Note that confidence in a negative test result based on a single specimen is limited.

Lithium–heparin (LiHep) blood specimens are not preferred. LiHep provides no test detection possibilities that are not available from clotted and EDTA specimens. LiHep blood is more likely to be inhibitory to PCR, which may give false negative results.

Submitting a combination of EDTA blood, serum, and nasal or other swabs should be sufficient for detection of HeV infection in a very high proportion of HeV-infected horses. Note that, although blood samples are preferred for obtaining a diagnosis, their collection presents a risk to the sample collector because of the need to handle sharps. Accordingly, blood samples should only be taken where workplace health and safety measures are implemented to mitigate the risk of needle and sharps injuries.

Other recommended specimens that could be taken if it is safe to do so include those listed in Table 2.1.

Table 2.1 Additional specimens for testing for Hendra virus

Specimen type	Specimen	Live horse	Dead horse
Swab	Conjunctiva	Y	Y
	Orifice (rectal, vaginal, urethral, buccal)	Y	Y
	Cut surface of mandibular lymph node		Y
Tissue ^a	Whole or part of mandibular lymph node		Y
	Other fresh or fixed samples		Y

^aTissues should only be collected if appropriate workplace health and safety controls are in place. They should not be collected routinely.

Specimens are to be packaged, transported and submitted to the laboratory in accordance with the regulations of the International Air Transport Association (IATA)⁶. Details are available in the Requirements for the Packaging and Transport of Pathology Specimens and Associated Materials⁷ produced by the National Pathology Accreditation Advisory Council, and relevant IATA references.

Laboratory diagnosis

HeV can be detected in the laboratory by virus isolation, PCR or serology (enzyme-linked immunosorbent assay — ELISA, or virus neutralisation test — VNT). All HeV exclusion testing should use a combination of PCR and serological assays, whenever suitable sample types and volumes are available.

PCR

PCR tests detect fragments of the HeV genome. A positive result indicates only the presence of viral genome in the sample; it does not indicate that the virus is viable and infectious. PCR testing results are generally available within 4–6 hours of receipt of samples.

A positive PCR test on samples collected on separate occasions and consistent with virus replication, or of sufficient magnitude to suggest that contamination of samples is improbable, without relevant clinical signs, is interpreted to mean that the animal has been, or is, infected and may still have viable virus within its body (eg within the central nervous system).

A negative PCR test needs to be interpreted in relation to the health of the animal and the broader epidemiological context. The animal could be in the early stages of infection with HeV (resulting in a low concentration of virus, or absence of virus at sampled sites), or may have recovered from infection.

PCR testing of close-contact dogs and cats should be undertaken as close as possible to the date of first infectious contact to establish a baseline. This may be paired with later samples to determine the infectious risk of the animal. PCR results on one sample should be interpreted in conjunction with other PCR and serology results.

⁶ www.iata.org

⁷ www1.health.gov.au/internet/main/publishing.nsf/Content/health-npaac-docs-PackTransPathSpecimens.htm

Serology

Serological tests for HeV, including ELISA and VNT, are conducted on serum samples and detect the presence of antibodies to HeV. The ELISA is a screening test, whereas the VNT is a confirmatory test. The current ELISA test has only been validated in horses and is not used in other species. VNTs are conducted on all dog and cat samples, and for confirming positive results from ELISA in unvaccinated suspect horses.

Since it may take an animal 5–10 days to produce antibodies after infection, a single serological test might not detect antibodies while an animal is incubating the disease or in the early stages of clinical infection.

A negative ELISA result is a reliable indicator that a horse has not been previously infected with HeV or vaccinated. Infected and vaccinated horses should return a positive ELISA result, but so may nonspecific reactors. Where such a result is obtained, the vaccination status of the animal should be clarified, and the animal should be tested by VNT.

A positive VNT result indicates that the animal is seropositive to HeV, from either infection or vaccination. A negative VNT result means that the animal is not seropositive to HeV.

The VNT is the 'gold standard' and the most specific test for anti-HeV antibodies. Its use is limited by the need to use live, infectious HeV in the test. This restricts conduct of the VNT for animal submissions to the CSIRO Australian Animal Health Laboratory (CSIRO-AAHL).

The VNT may take 4–5 days to complete, excluding the time it takes for the sample to reach a laboratory. Testing can sometimes take longer, and resampling may be required if samples are unsuitable.

HeV serological testing of vaccinated horses - Both vaccination with sG recombinant subunit vaccine (see Section 2.5.4) and natural infection induce neutralising anti- G antibodies. None of the standard assays differentiate between the anti-G antibodies produced in response to infection and those produced in response to vaccination.

Virus isolation

HeV isolation can be undertaken at CSIRO-AAHL and is frequently requested on index cases. Virus isolation confirms the presence of the virus; however, negative results do not indicate that the animal is, or was, not infected with HeV because the virus can be difficult to isolate. Clinical findings and other laboratory tests that are more sensitive for the detection of genetic material (PCR) and an immunologic response (serology) must be considered in interpreting negative virus isolation results.

Immunohistochemistry

HeV infection may also be confirmed in tissues using immunohistochemistry. Immunohistochemistry is most often used when fixed tissue is the only tissue available, or for pathogenesis studies.

Laboratory diagnostic capacity

PCR and ELISA testing can be undertaken at CSIRO-AAHL, Queensland's Biosecurity Science Laboratory, the Animal Health Laboratory in Western Australia, and the Elizabeth Macarthur Agricultural Institute in New South Wales. The Berrimah laboratory in the Northern Territory offers only PCR testing; and the Department of Economic Development, Jobs, Transport and Resources laboratory in Victoria offers only ELISA testing. VNT and virus isolation can only be undertaken at CSIRO-AAHL, which is the World Organisation for Animal Health (OIE) and national reference laboratory for HeV.

2.5 Epidemiology

2.5.1 Incubation period

To date, 80% of known equine cases have had an incubation period of 12 days or less, and 95% have had an incubation period of 15 days or less. No known HeV-positive equine cases have had an incubation period greater than 16 days, and three papers (Murray et al 1995, Baldock et al 1996, Field et al 2010) report a minimum 4-day incubation period for both experimental and natural infections. One paper reported an incubation period of 3–10 days (Baldock et al 1995). For the purpose of determining an appropriate quarantine period, 20 days has been determined to be appropriate, based on the maximum known incubation period of 16 days plus an additional 4 days as a precautionary measure.

Information on the incubation period in cats and dogs is limited. In one experimental study, cats inoculated with HeV had incubation periods of 4–8 days, whereas an in-contact cat developed disease after 12 days (Westbury et al 1996). Williamson et al (1998) reported incubation periods of 7 and 10 days in two experimentally infected cats. The incubation period for the two field HeV cases in dogs reported to date is undetermined because the time of exposure is unknown. Because of the limited number of cases in dogs and cats, a maximum incubation period of 16 days should be applied for both; as with horses, a safety margin of 4 additional days is used for the purposes of tracing, surveillance (ie daily observations) and quarantine periods.

Findings from the HeV commissioned research program have confirmed that dogs acutely infected with HeV can be a transmission risk (Middleton 2016b). HeV was isolated from the oral cavity of acutely infected dogs on days 2 and 4 after exposure. Once dogs have developed neutralising antibodies, they are no longer a transmission risk. Infected dogs need to be isolated and quarantined during the acute disease phase, and until they are PCR negative and antibody positive. Cats show clinical signs experimentally; if naturally infected, they would also constitute a transmission risk and require the same stringent biosecurity measures as dogs.

2.5.2 Persistence of agent

HeV is a lipid-enveloped virus, and is susceptible outside the host to desiccation and changes in temperature (Fogarty et al 2008). Experimental evidence indicates that HeV survival in the environment varies from several hours to several days, depending on environmental conditions (Fogarty et al 2008). HeV survival rates 24 hours after excretion ranged from 2% to 10% in summer, and from 12% to 33% in winter, based on air temperatures (Martin et al 2015).

HeV transmission probably involves direct contact of horses with fresh bat excreta during spillover events, and the effective time for transmission is likely to be shortly after excretion (Edson et al 2015a, Martin et al 2015). The timing and geographic distribution of HeV spillover events cannot be fully explained by virus survival in the environment because spillover events have occurred when the suitability of temperatures for virus survival was intermediate to very low; this suggests that a seasonal factor other than temperature may be involved in the occurrence of spillovers. The availability of food for flying foxes has been suggested as one possibility (Martin et al 2015). Field et al (2015) also explored the relationship between winter temperature and HeV excretion patterns, and suggested that thermoregulation may impair immune system function.

Fogarty et al (2008) reported the following:

- HeV in flying fox urine (pH ~7) survived for more than 4 days at 22 °C, with a half-life of 19 hours; at 37 °C, it was mostly inactivated in less than 1 day, with a half-life

of 3 hours.

- HeV survival on mango fruit flesh at 22 °C decreases with increasing acidity. At pH 5, half-life is 22 hours, whereas at pH 3 it is 0.3 hours.
- HeV survival on fruit pulp and in fruit juice varies, depending on the type and pH of the fruit. Virus incubated in lychee juice showed greater persistence than in either pawpaw or mango juice, with 2–3-fold longer half-lives and survival for more than 3 days.
- HeV is rapidly inactivated by desiccation at both 22 °C and 37 °C. Virus survival after desiccation in the laboratory is reported as less than 15 minutes at 37 °C. At 22 °C, HeV levels decreased by more than 3 logs within 30 minutes (half-life of 1.2 minutes).

For the purposes of disease control, 5 days is presumed to be the maximum survival time for HeV under optimal environmental conditions — that is, neutral pH, moist air and moderate temperatures. This survival time is doubled to 10 days as a precautionary measure.

Persistence of infection

Experimental work in ferrets and mice has failed to demonstrate re-isolation of virus from brain tissue in convalescent animals (Middleton 2016a). In mice, HeV spread in the brain is by a neurone-to- neurone cell-mediated mechanism, rather than a virus-mediated infectious process (Dups et al 2012, Middleton 2016a). A small number of people who recovered from initial infection with HeV or Nipah virus subsequently relapsed or developed delayed-onset encephalitis (WHO 2009ab). Viable virus has not been able to be recovered from naturally infected convalescent or recrudescing human or horse HeV cases.

2.5.3 Modes of transmission

Although the exact route of transmission is not known, it is thought that horses become infected with HeV by contact with material contaminated by infected flying fox body fluids and/or excretions. It is also plausible that horses may become infected directly through droplet inhalation via the nasal route (Mori et al 1995, Rudd et al 2006, Dups et al 2012, Munster et al 2012). Once a horse becomes infected, there is the potential for HeV to be transmitted to other horses, humans and other susceptible species⁸.

Current field and experimental knowledge indicates that HeV is most likely transmitted from horses to other animals or humans by contact with infected body fluids or tissues, or through droplet transmission. Undertaking certain procedures on horses (eg endotracheal intubation, nasal lavage, necropsy) may increase the risk of infection for attending personnel by promoting droplet or aerosol generation. It is not definitively known how natural infection in dogs occurs; close contact with infected horses is suspected.

No definitive studies have been found describing the distance over which respiratory droplets can spread from horses. A maximum distance of 5 metres is assumed, based on the absence of transmission to horses beyond this distance in field scenarios, qualitative extrapolation of droplet studies in humans, and observations of exhaling horses after exercise. This 5-metre distance can be extended if circumstances indicate that additional precautions are appropriate (El Saadi et al 2014).

Current evidence suggests that, although there is some risk of transmission in the preclinical phase, transmission risk increases with disease progression, and is highest when the horse is near death and immediately postmortem.

Viral genetic material was identified in three experimentally infected horses 3–5 days before the appearance of clinical signs (Marsh et al 2011). Further, the same authors reported that most tissues and organs contained HeV at the time of death (euthanasia). The report indicates that nasal secretions of

⁸ Susceptible species are those terrestrial domestic animals shown to be experimentally or naturally susceptible to HeV.

subclinical horses may pose a transmission risk during the early phase of disease that precedes viraemia, fever or other discernible clinical signs of HeV infection. In light of this finding, people coming into contact with sick horses should give early consideration to HeV in the differential diagnosis and apply infection control procedures relating to blood, and oral and nasopharyngeal secretions. Personal protective equipment and other safety procedures are currently the primary defence in the preclinical phase when horses may excrete HeV⁹. Similar considerations apply to othersusceptible species and should guide human interactions with these species.

2.5.4 Disease prevention

An HeV recombinant subunit vaccine, based on a recombinant soluble version of the HeV attachment glycoprotein G (sG), was approved for use under a Minor Use Permit by the Australian Pesticides and Veterinary Medicines Authority in November 2012. The vaccine was granted full registration in August 2015, approved for use in pregnant mares in January 2016, and approved for annual boosters in May 2016.

The vaccine is available from veterinarians and administered by intramuscular injection to horses 4 months of age or older. Details on the recommended vaccination schedule, the administration site and possible adverse reactions associated with use of the vaccine are available from the manufacturer and on the product label.¹⁰

The vaccine is an important breakthrough in the options for preventing HeV infection, and is regarded as the most effective way to reduce the risk of infection (El Saadi et al 2014). However, as no vaccine is 100% effective, it is important that people in contact with horses continue to practise goodbiosecurity and infection control at all times, even with vaccinated horses.

⁹ Refer to the *Guidelines for Veterinarians Handling Potential Hendra Virus Infection in Horses*, produced by the Queensland Department of Agriculture, Fisheries and Forestry, for details of appropriate PPE

¹⁰ <https://portal.apvma.gov.au/pubcris>

3 Australia's policy

The consequences of Hendra virus (HeV) infection are potentially severe for humans and some susceptible animal species (other than pteropid bats). As a result, a conservative precautionary approach should be taken whenever HeV is considered as a differential diagnosis, to prevent infection of humans and other susceptible animals. Strict biosecurity and infection control procedures must be implemented until HeV infection can be excluded.

Under legislation in all Australian states and territories, suspect and confirmed cases of HeV infection must be notified to the relevant jurisdictional animal health authority. The animal health authority will work with the field veterinarian(s) to manage the investigation. Advice will also be provided to public health authorities.

The high case fatality rate for clinically affected horses means that most will die or be euthanased on welfare grounds, or at the owner's request. Where the chief veterinary officer (CVO) considers, on the basis of expert opinion (including on human health), that the biosecurity risks of cases cannot be safely managed, euthanasia may be mandated by the CVO to manage the risk of exposure. Very high safety standards are required to safely manage acute HeV cases.

The HeV response should focus on management of non-bat terrestrial animals. Culling or dispersal of flying fox colonies is not an effective strategy for controlling HeV, because flying foxes are highly mobile, and individuals move between colonies. It has been hypothesised that the stress associated with culling or dispersal could increase the excretion of HeV by flying foxes and therefore the risk of spillover to horses. However, recent research (Edson et al 2015b) has demonstrated no significant difference in HeV prevalence or mean cortisol levels before and after roost disturbance.

3.1 Case definition

The case definition of an HeV-infected animal is:

- –an animal (with or without clinical signs) that tests positive to HeV using one or more of the following tests
 - polymerase chain reaction (PCR)
 - virus isolation
 - immunohistochemistry, or
- an animal for which testing has not been possible or for which testing is inconclusive, but scientific evidence (clinical, laboratory, epidemiological) that the animal is/was infected is compelling (eg confirmed human infection following contact with an animal with clinical signs and history suggestive of HeV infection). Such status decisions are made by the jurisdictional chief veterinary officer (CVO).

Confidence in a PCR test result is increased by testing of multiple samples of different types. A single negative result on a single sample may be a false negative as a result of insufficient diagnostic material or low levels of RNA at the sampled site.

The case definition of an HeV-recovered animal is an animal:

- free from clinical signs suggestive of HeV infection, and
- PCR negative and with a detectable serum antibody response not consistent with its vaccination history, or
- for which testing has not been possible or for which testing is inconclusive but scientific

evidence (clinical, laboratory, epidemiological) that the animal was infected and no longer poses a transmission risk is compelling, in the opinion of the CVO.

The case definition of an HeV-vaccinated animal is an animal that has:

- a current vaccination status (ie evidence of vaccination following the recommended schedule), and/or
- an antibody response that is consistent with its known HeV vaccination status.

It is possible for an animal to be both antibody and PCR positive if sampled early in recovery. Although such results most likely reflect remnant RNA rather than viable virus, the PCR testing should be repeated until a negative result is obtained.

Where positive PCR results are obtained from nonclinical animals sampled at anatomical sites that are susceptible to environmental contamination (eg nasal cavity, oral cavity, rectum), or from samples where contamination cannot reasonably be excluded, confirmation that the animal was infected, to support the diagnosis of an HeV-recovered animal, may require demonstration of an antibody response.

Any vaccinated animal or recovered animal that also meets the criteria for an HeV-infected animal will be considered to be an HeV-infected animal, regardless of its circulating antibody level.

3.2 Cost-sharing arrangement

HeV infection is currently included as a Category 2 disease in the EAD Response Agreement. The costs of disease control would be shared 80% by governments and 20% by the relevant industries.

3.3 Summary of policy

HeV infection is not a World Organisation for Animal Health (OIE)-listed disease but is a notifiable terrestrial animal disease in all states and territories of Australia. The detection of HeV infection in animals in Australia results in minor animal and public health impacts, and moderate adverse social effects.

The policy is to control HeV infection in terrestrial animals using:

- stringent *biosecurity* and *workplace health and safety* measures to prevent humans and other susceptible animals from becoming infected
- an *epidemiological assessment*, including risk and exposure assessments of susceptible animals and premises, to provide information for management of the situation
- *quarantine, movement controls, monitoring, sampling and testing* of infected and close-contact susceptible animals until the risk of HeV spread from the infected or close-contact animal(s) has been appropriately minimised or mitigated, to prevent spread of the disease between properties and between animals on the affected property
- *sanitary disposal* of confirmed or presumed HeV-infected (terrestrial) animals that die or are euthanased
- *decontamination* of the contaminated environment by natural means (preferred) or application of decontaminants; and disposal or decontamination of contaminated fomites
- *tracing and surveillance* to determine the source and extent of infection

- communications and a *community engagement campaign* to inform, and address the concerns and needs of, industries and the community.

Supporting measures include:

- vaccinating horses, as the most effective way to reduce the risk of infection with HeV
- preventing susceptible terrestrial species (horses) on the property from sheltering under trees attractive to flying foxes, to limit the potential for further virus exposures on the premises
- continued practising of appropriate biosecurity precautions by all animal owners after quarantine and movement controls have been rescinded.

The website of the Queensland Department of Agriculture and Fisheries¹¹ provides comprehensive guidelines for disease management by private veterinarians.

The Queensland¹² and New South Wales¹³ governments implement well-established biosecurity and public health responses to Hendra virus incidents.

3.4 Epidemiological assessment

As part of the epidemiological assessment, animals, animal products and fomites are risk assessed for close contact with infected animals. The following definitions are used:

- An animal (eg horse, dog, cat) with **close contact** is one that
 - has come within 5 metres of a clinical HeV-positive horse, or
 - has come within 1 metre of a confirmed HeV-positive non-equid animal, or
 - has potentially had direct contact with presumed contaminated body fluids or substances from a clinical HeV-positive animal, a suspect animal or a recently deceased HeV-positive animal in the 10 days following excretion or secretion of the body fluids or substances, or
 - has potentially had contact with blood or nasopharyngeal secretions shed by preclinical animals in the 10 days before the onset of clinical signs — for example, through dental procedures, stomach tubing or very close nose-to-nose contact, or
 - has had direct contact with a contaminated fomite.
- A **contaminated fomite** is one that has had direct contact with body fluids (including nasopharyngeal secretions, urine or blood) or faeces from an HeV-positive animal or a suspect susceptible animal (this may be by contacting the infected animal or carcass) in the 10 days following secretion or excretion. This includes contact with blood or nasopharyngeal secretions from an HeV-positive animal that were secreted or excreted in the 10 days before the onset of clinical signs (ie preclinical).
- A **suspect animal** is any susceptible terrestrial domestic animal that is known to be experimentally or naturally susceptible to HeV and is showing signs of illness consistent with the current knowledge of HeV infection. Knowledge about potential clinical signs in field cases of suspect susceptible animals other than horses is limited and is based on observations in experimental settings. No discernible clinical signs were reported in the only two naturally infected dogs recognised to date.
- A **suspect response animal** is any susceptible terrestrial animal on a known infected premises (IP) showing signs of illness consistent with the current knowledge of HeV infection.

¹¹ www.daff.qld.gov.au

¹² www.daf.qld.gov.au/animal-industries/animal-health-and-diseases/a-z-list/hendra-virus/general-information

¹³ www.dpi.nsw.gov.au/agriculture/livestock/horses/health/general/hendra-virus

3.5 Quarantine and movement controls

Management of risk groups

Management of different groups of animals reflects the risk the animals pose for disease spread.

Infected animals are identified in the initial investigation or subsequently through follow-up testing of close-contact or suspect animals. An epidemiological assessment (Section 3.4) is completed to identify animals and fomites considered to have had close contact with the infected animal(s). Management of close-contact animals and fomites is described below.

Each risk group should be segregated to mitigate the risk of horizontal transmission and to allow different management practices for different groups.

If any close-contact or low-risk animal on an infected property shows clinical signs that could indicate HeV infection during the quarantine period, it should be segregated from other susceptible animals and tested to clarify its HeV status. Biosecurity controls should be commensurate with the risk status.

Management of HeV-infected animals

An infected animal will probably have already been sampled and confirmed as infected unless its status is based on epidemiological evidence.

A risk assessment must be undertaken to determine appropriate infection controls before personnel make close contact with the animal. The risk assessment should take into account animal welfare, human health risks and the wishes of the owner. The jurisdictional health department must be consulted as part of the risk assessment.

Management of infected animals is under the control of the jurisdictional CVO, on a case-by-case basis, taking into account animal welfare, human health risks and biosecurity obligations.

Euthanasia of infected animals is often undertaken because of animal welfare concerns or where the owner requests it. The jurisdictional CVO may also decide on euthanasia of infected animals to limit the opportunity for animal-to-animal and animal-to-human transmission if the biosecurity risks for ongoing care cannot be managed.

If the risk assessment indicates that the transmission risk and other issues such as animal welfare can be safely managed, veterinary management of the animal may continue under the control of the CVO.

Decisions about how infected animals will be managed are ongoing while the animal is under quarantine. They will rely on regular veterinary assessment of the animal's welfare, the owner's wishes, and satisfaction by the CVO that the biosecurity risks of providing ongoing treatment and care can be satisfactorily addressed.

The following requirements apply while infected cases are alive:

- An HeV-infected animal must be separated from nonclinical animals until it seroconverts, to limit the potential for horizontal disease transmission. For dogs and cats, this will mean confinement to a cage or lockable room. For horses, a fenced yard or stables with a minimum 5-metre buffer from susceptible species will be required.
- Quarantine and movement controls must be imposed for a minimum of 20 days, with strict biosecurity controls in place for this period.

- It can be challenging to maintain a high level of biosecurity during the provision of food and exercise for HeV-infected animals. Personnel should use strategies that minimise the need for frequent contact — for example, feeding over a fence, topping up water remotely, and ensuring that defecation and urination sites can be cleaned without direct animal contact. The CVO may approve lay personnel to undertake low-risk activities such as feeding and exercising HeV-infected animals, but will only do so after these personnel undergo training and demonstrate competence in the use of personal protective equipment (PPE). Administration of veterinary treatments to HeV-infected animals will be solely determined by the CVO.
- Animals that survive or are not euthanased require testing 20 days following the onset of clinical signs to detect the presence of antibody. PCR would normally be negative at 20 days, but there is the potential for viral genomic remnants to give false positive results. In such cases, the PCR test should be repeated until a negative result is obtained.

Once the CVO has determined that the animal is recovered and at least 20 days have elapsed since the onset of clinical signs, the quarantine can be removed.

Management of close-contact horses

Unvaccinated

Management of unvaccinated horses during a disease incident must be commensurate with the risk that the animals pose to other susceptible species, including humans.

The following requirements apply:

- Unvaccinated close-contact horses must be segregated into small groups away from the infected animal, contaminated area and contaminated fomites.
- Any unvaccinated close-contact horse must be quarantined, with movement and biosecurity controls applied for a minimum of 20 days.
- Strict biosecurity controls commensurate with those used for HeV-infected horses must be imposed on close-contact horses to minimise the risk of transmission to susceptible animals and humans during the infectious period.
- Options for management of unvaccinated close-contact horses are to be determined by each jurisdiction. They include:
 - applying quarantine, and movement and biosecurity controls; and testing as soon as possible after the first exposure to HeV, then 20 days after the last known exposure. If a close-contact horse is antibody positive and PCR negative, it is managed in the same way as a vaccinated horse (low risk). A horse that was PCR and antibody positive will have the PCR test repeated until a negative result is obtained
 - applying quarantine and movement controls, vaccinating for HeV as soon as possible after the first exposure to HeV, and monitoring for clinical signs consistent with HeV infection for
 - 20 days after the last known exposure
 - for horses that cannot be handled safely, taking no samples but monitoring for clinical signs consistent with HeV for 20 days after the last known or suspected exposure to HeV.

Vaccinated

Horses with a current HeV vaccination status are considered to be low risk, even if they have had close contact. These horses will not require any testing on the infected holding and are eligible to move off the infected property under permit. Once they move, they will not be subject to any government-regulated management (eg health monitoring, laboratory testing, quarantine, movement restrictions) at their destination.

All animal movements off quarantined holdings are by permit issued by an authorised officer. Individual jurisdictions will specify the details of permits in their own procedural documents. A movement permit will specify the destination, date of movement, and animal and owner details. Since no vaccine is 100% effective, and HeV is a serious zoonotic pathogen, owners should be advised to observe vaccinated horses for the next 16 days for any signs of ill health, and to practise good biosecurity and infection control at all times. A veterinarian should be consulted if any concerns arise during this monitoring period. This requirement should be noted as a special condition on the permit.

Although no specified testing protocols are required for low-risk animals moving off quarantined holdings, the CVO may in some instances specify a specific condition based on a risk assessment. For example, a vaccinated horse that has been housed with a clinical horse may require a disinfectant spray before it is moved.

Management of close-contact non-equid susceptible species

Non-equid susceptible species include dogs, cats and other susceptible species that are present on an IP.

Management must be commensurate with the risk that the animals pose to other susceptible species, including humans.

If, after consultation with the animal's owner, a close-contact non-equid animal is unable to be safely managed to control the biosecurity risks to other susceptible species during the quarantine period, the CVO may consider euthanasia to eliminate the risk. Euthanasia of the animal may also be requested by the owner where the animal's management is stressful, or to eliminate the risk of possible human exposure, particularly for children.

The following requirements apply:

- Strict biosecurity controls commensurate with those used for HeV-infected animals must be imposed on close-contact animals to minimise the risk of transmission to susceptible animals and humans during the quarantine period.
- Dogs and cats must not be allowed to come into contact with other susceptible animals that maybe potentially shedding viable virus (eg close-contact animals).
- Any cat or dog that may have had contact with an HeV-infected animal or its fluids must be confined for a minimum of 20 days. 'Confined' means that the animal is restricted to a locked room or cage. Additional biosecurity measures will be required, including use of PPE and no handling of the pet.
- If it can be done safely, sampling of close-contact dogs, cats and other non-equine susceptible species will be undertaken. This should occur as early as possible after the last infectious contact to establish whether there is probable infection with HeV. PCR will be undertaken on blood and swabs (urine, oral, nasal or rectal), together with serology.
 - If PCR and serology are both negative, it is likely that the animal has not been exposed.
 - However, it is possible that the animal could be incubating HeV, and appropriate biosecurity controls and confinement must be applied for 20 days after the last potential contact.
 - If an animal tests PCR negative and seropositive, the biosecurity controls are removed and it is managed as described under 'Management of remaining susceptible animals on an infected premises' (below).
 - If the animal tests PCR positive and seronegative, it is managed as an infected animal, and strict biosecurity controls must be applied to limit the potential for infection of other susceptible terrestrial animals. Further sampling is at 20 days following the last potential infectious contact, to detect seroconversion and a PCR negative result. If no antibodies are detected, biosecurity controls must be maintained until it is certain that the animal is immune (ie has seroconverted) or until the positive PCR finding from sampling on day 0 can

be adequately explained as a false positive, or a true positive resulting from contamination or other events.

- If the animal tests PCR positive and seropositive, strict biosecurity controls must remain in place, and PCR testing must be repeated until a negative result is obtained.

Management of close-contact fomites

Close-contact fomites identified in the epidemiological assessment (eg float, tack) must remain on the quarantined property until they have been decontaminated (see Section 3.11).

Management of remaining susceptible animals on an infected premises

Animals that are not close contact or suspect are classified as low interest. They need not be sampled, but must be observed as for any other animal under the owner's control and kept segregated from HeV-infected or close-contact animals.

Management of clinically well serological positives

If a close-contact animal is found to be serologically positive and PCR negative, it is low risk and managed accordingly.

Serologically positive animals not associated with a disease event could also be identified during routine testing for various reasons, including export testing. If the animal has not been vaccinated, these results may reflect recovery from HeV infection, or a previous subclinical infection. These animals are also of low risk and are managed similarly to vaccinated animals.

Human health precautions

Human access to contaminated areas and to animals that have been assessed as other than low risk should be avoided as far as possible. Appropriate infection control procedures, including PPE, should be used if access to contaminated areas and close-contact unvaccinated animals is necessary.

Appropriate workplace health and safety precautions (eg use of appropriate animal restraint and PPE) must be in place before animals are examined or samples are taken. Human health and safety must be considered when fluid and tissue samples are taken from HeV-positive, close-contact or suspect animals. Where necessary, to mitigate the human health risk, specialist pathologists with expertise in working with highly pathogenic zoonoses may be commissioned to assist with high-risk procedures, such as necropsy of HeV-positive animals.

In some jurisdictions, both the veterinarian and the property owner must report any confirmed HeV incident to the jurisdiction's work health and safety authority.

Whenever consideration is being given to possible human exposure to HeV on infected properties, the public health unit must be consulted. Issues to be considered include risk assessment of the management of infected animals, and use of PPE for interactions with infected and suspect animals.

3.6 Tracing

The incubation period (and safety margin), virus survivability and preclinical shedding are important factors to consider when conducting tracing. Tracing should be undertaken in the following priority order:

1. Identification of susceptible animals in close contact (see above) with the infected horse.
2. Tracing of movements of horses, dogs and cats to and from the IP for 16 days before the first observation of unusual morbidity or mortality, to identify any animals that may have been infected at or around the same time as the infected animal. (Note: dogs have demonstrated either no clinical signs or only mild, transient clinical signs following experimental or natural infection with HeV.)
3. Tracing of movements of close-contact fomites (see Section 3.5). Tracing of fomites for the 10 days before unusual morbidity or mortality was observed on the IP will primarily relate to items contaminated by moderately invasive procedures involving the nasopharyngeal area of horses (eg stomach tubing, endoscopy, dental work).
4. Tracing of movements of people involved with the IP (eg veterinarians, farriers, feed delivery drivers, tradespeople, company service personnel) who potentially had contact with infected animals or contaminated fomites during the 10 days before the animal showed clinical signs and in the period until the animal died or was euthanased. The national public health response is detailed in *Hendra Virus: National Guidelines for Public Health Units*¹⁴. States and territories may have similar documents.¹⁵

3.7 Sampling timeframes

Interpreting results

Diagnostic samples required are listed in Section 2.4.

If results from the first samples taken from a close-contact animal (horses and non-equid animals) as soon as possible after the date of last infectious contact are:

- PCR negative and antibody positive, the animal can be reclassified as low risk
- PCR positive and antibody negative, the animal will be quarantined, with movement and biosecurity controls applied for 20 days to allow immunity to develop
- PCR negative and antibody negative, the animal will be quarantined, with movement and biosecurity controls applied for 20 days to allow observation of clinical signs (eg horses, cats) and/or development of immunity (all susceptible terrestrial species)
- PCR positive and antibody positive, biosecurity will be maintained, and sampling will be repeated until a negative PCR result is obtained.

Quarantine will be subject to an exposure assessment — if the animal is not considered to be a close-contact animal, quarantine will not be required.

¹⁴ www.health.gov.au/internet/main/publishing.nsf/Content/cdnasongs.htm

¹⁵ For example, www.health.qld.gov.au/cdcg/index/hendra.asp

3.8 Release from quarantine and movement controls

Release from quarantine and movement controls can occur:

- 10 days after the last potential contamination of the premises by fluids or wastes from an infected animal, where no infected, suspect or close-contact animals remain on the premises (based on maximum virus survival time in the environment), or
- after diagnostic tests confirm immunity in infected animals (antibody positive, PCR negative) or lack of evidence of infection (antibody negative) in exposed animals 20 days from the date of confirmation of disease in a single animal case, or from the date of last infectious contact in a multi-animal case, and the disease control authority managing the incident considers that any residual risk of HeV on the premises can be appropriately managed through biosecurity controls.

It is important to note that PCR tests may produce positive results for extended periods as a result of the presence of genomic remnants. If repeat testing does not produce a negative PCR, the CVO may release all regulatory controls if satisfied that the animal does not constitute a transmission risk.

3.9 Destruction

Acutely infected animals have a high fatality rate and are managed on a case-by-case basis under the authority of the jurisdictional CVO. This requires ongoing assessment of animal welfare, biosecurity risks and the wishes of the owner.

Previously, the national policy for dealing with non-bat terrestrial animals¹⁶ that are confirmed as infected was humane destruction, because of concerns that recrudescence could create a future transmission risk for other animals and people. However, field investigations, experimental models and recent work undertaken at CSIRO show that the pathogenesis of relapsing encephalitis as seen in recrudescence HeV infection is different from that seen in acute infection, and there is no evidence that such animals pose a transmission risk to other animals or people (Dups et al 2012, Middleton 2016a).

Animals that recover from HeV infection (PCR negative and antibody positive) are therefore not considered to be a transmission risk. Accordingly, they need not be euthanased.

Euthanasia is undertaken for animal welfare reasons, or if biosecurity controls during the acute disease phase cannot be safely managed, or if the animal's owner requests it.

It can be challenging to humanely euthanase an animal while wearing PPE. The risk of blood exposure or needlestick injury during venepuncture is significant, and mobility and vision can be impaired when working in PPE. Preplanning is essential. The number of personnel involved should be minimised, and all personnel should be competent in using PPE.

3.10 Disposal

Animals should be disposed of by an appropriate means, as described in the AUSVETPLAN **Disposal Manual**. Consideration must be given to on-site or off-site disposal, and the advantages and disadvantages associated with each. In most circumstances, disposal on-site by deep burial or composting is the preferred option. Disposal must be in accordance with jurisdictional, local government and environmental protection legislation and guidelines.

¹⁶ Terrestrial animals (does not include bats) known to be susceptible to infection with HeV under experimental or natural conditions

3.11 Decontamination

Wherever possible, it is preferable that decontamination be allowed to occur naturally through time and environmental processes. Under natural conditions and after application of a conservative precautionary approach, contaminated areas and fomites will be considered decontaminated 10 days after the last known exposure to HeV (based on a doubling of the maximum survival time of 5 days). If an area, such as a laboratory postmortem room, or object requires decontamination, the AUSVETPLAN **Decontamination Manual** should be consulted; decontaminants that are active against Category A viruses are appropriate for HeV.

Glossary

Disease-specific terms

Term	Definition
Close-contact animal	<p>An animal (eg horse, dog, cat) that:</p> <ul style="list-style-type: none"> • has come within 5 metres of a clinical HeV-positive horse, or • has come within 1 metre of a confirmed HeV-positive non-equid animal, or • has potentially had direct contact with presumed contaminated body fluids or substances from a clinical HeV-positive animal, a suspect animal or a recently deceased HeV-positive animal in the 10 days following excretion or secretion of the body fluids or substances, or • has potentially had contact with blood or nasopharyngeal secretions shed by preclinical animals in the 10 days before the onset of clinical signs — for example, through dental procedures, stomach tubing or very close nose-to-nose contact, or • has had direct contact with a contaminated fomite.
Confined	Where the animal is restricted to a locked room or cage. Additional biosecurity measures will be required, including use of personal protective equipment and no handling of the pet.
Contaminated area	The area within 5 metres of an HeV-infected horse.

Standard AUSVETPLAN terms

Term	Definition
Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hoofs, bones, fertiliser).
Animal Health Committee	A committee whose members are the chief veterinary officers of the Commonwealth, states and territories, along with representatives from the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP) and the Australian Government Department of Agriculture, Water and the Environment. There are also observers from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries. The committee provides advice to the National Biosecurity Committee on animal health matters, focusing on technical issues and regulatory policy. <i>See also</i> National Biosecurity Committee
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved disposal site	A premises that has zero susceptible livestock and has been approved as a disposal site for animal carcasses, or potentially contaminated animal products, wastes or things.

Term	Definition
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility that maintains increased biosecurity standards. Such a facility could have animals or animal products introduced from lower-risk premises under a permit for processing to an approved standard.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Water and the Environment who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. <i>See also</i> Chief veterinary officer
AUSVETPLAN	<i>Australian Veterinary Emergency Plan</i> . Nationally agreed resources that guide decision making in the response to emergency animal diseases (EADs). It outlines Australia's preferred approach to responding to EADs of national significance, and supports efficient, effective and coherent responses to these diseases.
Carcase	The body of an animal slaughtered for food.
Carcass	The body of an animal that died in the field.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. <i>See also</i> Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with OIE guidelines, based on applied biosecurity measures and surveillance, to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. <i>See also</i> Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory chief veterinary officers, representatives of CSIRO-ACDP and the relevant industries, and the Australian Chief Veterinary Officer as chair.
Control area (CA)	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Cost-sharing arrangements	Arrangements agreed between governments (national and state/territory) and livestock industries for sharing the costs of emergency animal disease responses.

Term	Definition
	<i>See also</i> Compensation, Emergency Animal Disease Response Agreement
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery or milk processing plant (or other such facility) that, after investigation and based on a risk assessment, is considered to contain a susceptible animal(s) not showing clinical signs, but considered highly likely to contain an infected animal(s) and/or contaminated animal products, wastes or things that present an unacceptable risk to the response if the risk is not addressed, and that therefore requires action to address the risk.
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility that, based on a risk assessment, appears highly likely to have received infected animals, or contaminated animal products, wastes or things, and that requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. There are two types of declared areas: restricted area and control area.
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
Disinsection	The destruction of insect pests, usually with a chemical agent.
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. <i>See also</i> Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained

Term	Definition
	personnel and existing standards such as AUSVETPLAN. <i>See also</i> Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. <i>See also</i> Emergency animal disease, Exotic animal disease
Enterprise	<i>See</i> Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen-antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. <i>See also</i> Veterinary investigation
Epidemiology	The study of disease in populations and of factors that determine its occurrence.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. <i>See also</i> Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	<i>See</i> Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> Special permit
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of a pathogen into an animal and the first clinical signs of the disease.
Index case	The first case of the disease to be diagnosed in a disease outbreak. <i>See also</i> Index property
Index property	The property on which the index case is found. <i>See also</i> Index case
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease is present, or there is a reasonable suspicion that either is present, and that the relevant chief veterinary officer or their delegate has declared to be an infected premises.

Term	Definition
Local control centre (LCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.
Monitoring	Routine collection of data for assessing the health status of a population or the level of contamination of a site for remediation purposes. <i>See also</i> Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National Biosecurity Committee (NBC)	A committee that was formally established under the Intergovernmental Agreement on Biosecurity (IGAB). The IGAB was signed on 13 January 2012, and signatories include all states and territories except Tasmania. The committee provides advice to the Agriculture Senior Officials Committee and the Agriculture Ministers' Forum on national biosecurity issues, and on the IGAB.
National Management Group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture, Water and the Environment as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	<i>See</i> Wild animals
OIE Terrestrial Code	OIE <i>Terrestrial animal health code</i> . Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access .
OIE Terrestrial Manual	OIE <i>Manual of diagnostic tests and vaccines for terrestrial animals</i> . Describes standards for laboratory diagnostic tests, and the production and control of biological products (principally vaccines). The current edition is published on the internet at: www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access .
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Polymerase chain reaction (PCR)	A method of amplifying and analysing DNA sequences that can be used to detect the presence of viral DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected

Term	Definition
	premises, suspect premises, trace premises, dangerous contact premises or dangerous contact processing facility.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Proof of freedom	Reaching a point following an outbreak and post-outbreak surveillance when freedom from the disease can be claimed with a reasonable level of statistical confidence.
Qualifiers	
– assessed negative	Assessed negative (AN) is a qualifier that may be applied to ARPs, PORs, SPs, TPs, DCPs or DCPFs. The qualifier may be applied following surveillance, epidemiological investigation, and/or laboratory assessment/diagnostic testing and indicates that the premises is assessed as negative at the time of classification.
– sentinels on site	Sentinels on site (SN) is a qualifier that may be applied to IPs and DCPs to indicate that sentinel animals are present on the premises as part of response activities (ie before it can be assessed as an RP).
– vaccinated	The vaccinated (VN) qualifier can be applied in a number of different ways. At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against the EAD in question. However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used to track a range of criteria and parameters.
Quarantine	Legally enforceable requirement that prevents or minimises spread of pests and disease agents by controlling the movement of animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures, and is subject to the procedures and restrictions appropriate to the area in which it is located.
Restricted area (RA)	A relatively small legally declared area around infected premises and dangerous contact premises that is subject to disease controls, including intense surveillance and movement controls.
Risk enterprise	A defined livestock or related enterprise that is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges and garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. <i>See also Specificity</i>
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.

Term	Definition
Seroconversion	The appearance in the blood serum of antibodies (as determined by a serology test) following vaccination or natural exposure to a disease agent.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Slaughter	The humane killing of an animal for meat for human consumption.
Special permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. <i>See also</i> Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
State coordination centre (SCC)	The emergency operations centre that directs the disease control operations to be undertaken in a state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease.
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. or An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises (SP)	Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s).

Term	Definition
Swill	<p>Also known as 'prohibited pig feed', means material of mammalian origin, or any substance that has come in contact with this material, but does not include:</p> <p>(i) Milk, milk products or milk by-products either of Australian provenance or legally imported for stockfeed use into Australia.</p> <p>(ii) Material containing flesh, bones, blood, offal or mammal carcasses which is treated by an approved process.¹</p> <p>(iii) A carcass or part of a domestic pig, born and raised on the property on which the pig or pigs that are administered the part are held, that is administered for therapeutic purposes in accordance with the written instructions of a veterinary practitioner.</p> <p>(iv) Material used under an individual and defined-period permit issued by a jurisdiction for the purposes of research or baiting.</p> <p>¹ In terms of (ii), approved processes are:</p> <ol style="list-style-type: none"> 1. rendering in accordance with the 'Australian Standard for the Hygienic Rendering of Animal Products' 2. under jurisdictional permit, cooking processes subject to compliance verification that ensure that a core temperature of at least 100 °C for a minimum of 30 minutes, or equivalent, has been reached. 3. treatment of cooking oil, which has been used for cooking in Australia, in accordance with the 'National Standard for Recycling of Used Cooking Fats and Oils intended for Animal Feeds' 4. under jurisdictional permit, any other nationally agreed process approved by AHC for which an acceptable risk assessment has been undertaken and that is subject to compliance verification. <p>The national definition is a minimum standard. Some jurisdictions have additional conditions for swill feeding that pig producers in those jurisdictions must comply with, over and above the requirements of the national definition.</p>
Swill feeding	<p>Also known as 'feeding prohibited pig feed', it includes:</p> <ul style="list-style-type: none"> • feeding, or allowing or directing another person to feed, prohibited pig feed to a pig • allowing a pig to have access to prohibited pig feed • the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept • supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig. <p>This definition was endorsed by the Agriculture Ministers' Council through AGMIN OOS 04/2014.</p>
Trace premises (TP)	Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to the

Term	Definition
	disease agent, or contains contaminated animal products, wastes or things, and that requires investigation(s).
Tracing	The process of locating animals, people or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Unknown status premises (UP)	A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.
Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products or a synthetic substitute, which is treated to act as an antigen without inducing the disease.
- adjuvanted	A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).
- attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
- gene deleted	An attenuated or inactivated vaccine in which genes for non-essential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.
- inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
- recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
- native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
- feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
- exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).

Term	Definition
Wool	Sheep wool.
Zero susceptible species premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with OIE guidelines, based on geopolitical and/or physical boundaries and surveillance, to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

Disease-specific abbreviations

Abbreviation	Full title
HeV	Hendra virus
PPE	personal protective equipment
VNT	virus neutralisation test

Standard AUSVETPLAN abbreviations

Abbreviation	Full title
ACDP	Australian Centre for Disease Preparedness
AN	assessed negative
APF	approved processing facility
ARP	at-risk premises
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DCPF	dangerous contact processing facility
EAD	emergency animal disease
EADRA	Emergency Animal Disease Response Agreement
EADRP	Emergency Animal Disease Response Plan
EDTA	ethylenediaminetetraacetic acid (anticoagulant for whole blood)
ELISA	enzyme-linked immunosorbent assay
GP	general permit
IETS	International Embryo Technology Society
IP	infected premises
LCC	local control centre
NASOP	nationally agreed standard operating procedure
NMG	National Management Group

Abbreviation	Full title
OA	outside area
OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
POR	premises of relevance
RA	restricted area
RP	resolved premises
SCC	state coordination centre
SP	suspect premises
SpP	special permit
TP	trace premises
UP	unknown status premises
ZP	zero susceptible species premises

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