Department of **Employment, Economic Development and Innovation**
Biosecurity Queensland

Guidelines for veterinarians handling potential Hendra virus infection in horses

Version 4.2

Queensland Government

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Summary of changes from previous version of this document (Version 4.1 March 2011).

- Content has been updated to include information from the Hendra virus (HeV) incidents in 2011. New epidemiological information has been added, including the finding of antibodies in a dog for the first time outside of an experimental or research setting.
- Additional references and reference material have been included.
- Appendix 1 has been updated with the most recent HeV incidents.

This document is subject to regular review. Comments on its content and format are encouraged.

The most recent edition of this document is located on the Biosecurity Queensland website www.biosecurity.qld.gov.au

Contents

1. Purpose

These guidelines are specifically intended to assist veterinarians in the safe investigation of illness in horses where Hendra virus (HeV) is considered as a possible cause.

Whenever this is the case, a professional risk management approach is required. The investigating veterinarian must then manage the level of risk assessed for the situation—the serious zoonotic nature of HeV requires taking stringent infection control precautions that may be in addition to those of normal practice.

These guidelines recognise that investigation and management of possible HeV cases will continue to be a joint approach between private veterinary practitioners and Biosecurity Queensland. It is expected that private veterinary practitioners will investigate and sample ill horses and will notify Biosecurity Queensland about possible HeV cases (see section 4.2 'Case definition').

There may be circumstances where a private veterinary practitioner may not be in a position to manage the level of associated risk. In these cases, the private veterinary practitioner and Biosecurity Queensland will need to consult.

These guidelines do not address day-to-day work practices and any changes to those practices that the veterinary profession may introduce as a result of HeV incidents and new information.

These guidelines concentrate on investigation of exclusion and suspect cases of HeV in horses. Biosecurity Queensland encourages private veterinary practitioners to use these guidelines as appropriate in supporting the development of infection control procedures for routine veterinary practice.

All veterinary investigations of horses should be conducted using the G*uidelines for veterinary personal biosecurity* developed by the Australian Veterinary Association. These are available from their website at www.ava.com.au

The *Guidelines for veterinarians handling potential Hendra virus infection in horses* will be updated as more knowledge and information becomes available. The current version of these guidelines is available at www.biosecurity.qld.gov.au

2. Scope

This document is intended for use by veterinarians to help them implement appropriate infection control procedures to manage the risk from HeV when investigating illness in horses. It provides information that relates to:

- identification of possible cases
- safe work practices to prevent personal infection, including the use of personal protective equipment (PPE) and development of personal biosecurity procedures
- responsibilities of people involved with the case.

Investigation and management of HeV exclusion and suspect cases is a joint responsibility between private veterinary practitioners and Biosecurity Queensland.

The primary role for Biosecurity Queensland is to:

- accept samples and conduct laboratory testing
- manage positive cases in animals
- provide advice and information to private veterinary practitioners about HeV.

On confirmation of a positive HeV case in an animal, Biosecurity Queensland will manage the case.

For the purpose of this document, we have assumed that:

- all exclusion and suspect HeV cases will be notified to Biosecurity Queensland as required under legislation. Notification to a government veterinary officer can be made by contacting **13 25 23** (business hours) or **1800 675 888** (24 hours), or through direct contact with a government veterinary officer
- exclusion and suspect cases will be investigated by private veterinary practitioners as part of normal practice using these guidelines and their own procedures as a reference
- private veterinary practitioners should make the final decision about whether to collect samples and submit them for laboratory testing with reference to these guidelines and, where required, obtain advice from Biosecurity Queensland
- Biosecurity Queensland will manage confirmed HeV cases in animals
- private veterinary practitioners will apply appropriate infection control procedures to protect themselves and others against HeV risk from horses that may be in the pre-clinical phase and excreting HeV but not showing any clinical signs.

3. Reference information

3.1. General

HeV was first isolated during 1994 when it occurred in a stable in the suburb of Hendra, Brisbane. Early names included acute equine respiratory syndrome and equine morbillivirus. However, following characterisation of the virus, it is now termed HeV. HeV and Nipah virus form the genus *Henipavirus* in the family Paramyxoviridae.

Flying foxes are a host reservoir of HeV. 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.

HeV has the potential to be a serious zoonotic disease for which stringent biosecurity and safety measures are necessary. There are important public health and workplace health and safety issues that require consideration. Careful risk management of the situation, safe work practices and PPE are required to manage potential exposure.

While much is now known about HeV, the scientific information available for HeV is not complete and there may be insufficient scientific knowledge to answer some questions that are posed. Within a standard risk management matrix, the consequences of HeV infection are classified as being potentially catastrophic for both horses and humans. As a result, a conservative 'precautionary principle' approach should be taken whenever uncertainty exists—that is, procedures should be put in place to limit possible harm in all cases where HeV is considered as a differential diagnosis.

Given the potential consequences of HeV, it is vital that exclusion and suspect cases be notified and investigated. As is always the case when dealing with a disease situation, it may not be clear from the outset that HeV is involved. However, if HeV is included as a differential diagnosis then, as a precautionary measure, the veterinarian should implement the safety precautions discussed in these guidelines until such time as HeV infection can be excluded.

Veterinarians who treat horses should:

- review their existing work practices so that individual assessment of horses for zoonotic diseases and prevention of potential transmission of these diseases to humans and other horses is built in to normal procedures
- develop plans for responding to a potential HeV case, including minimising risk to themselves, their workers and others (including clients)
- review their infection control procedures as these currently provide the best protection during the pre-clinical phase of HeV infection, where horses can excrete virus before showing overt clinical signs. Procedures must be in place to ensure the routine cleaning and disinfection of equipment (e.g. stomach tubes, endoscopes, dental equipment etc.) between horses. (Refer to Australian Standards 4815 and 4817 for more information about the reprocessing of instruments and equipment.)
- apply their professional judgement in the interpretation of laboratory results and seek advice as required.

Note: The report *Initial experimental characterisation of HeV (Redland Bay 2008) infection in horses*, authored by D Middleton, CSIRO Australian Animal Health Laboratory (AAHL), indicates that infected horses have a potential to excrete virus through nasal secretions from two days following exposure to HeV, up to and including the time that clinical signs appear. Appropriate infection control procedures should be applied in light of this finding, as such procedures currently appear to be the primary defence in the pre-clinical phase, where horses may excrete HeV but still appear clinically normal. A scientific paper has been published on the work undertaken in this report.[1]

[1] Marsh, GA, Haining, J, Hancock, TJ, Robinson, R, Foord, AJ, Barr, JA, Riddell, S, Heine, HG, White, JR, Crameri, G, Field, HE, Wang, L-F and Middleton, D 2011, 'Experimental infection of horses with Hendra virus/Australia/Horse/2008/Redlands' *Emerging Infectious Diseases* 17(12), DOI: 10.3201/eid1712.111162.

3.2. Epidemiology

Epidemiological information about HeV is incomplete and remains the subject of ongoing research. This section will be updated as new information becomes available.

Until 2011, there had been 14 incidents of HeV over a 17-year period from 1994 to 2010 (see Table 1). In 2011, there were 10 HeV incidents in Queensland and 8 in New South Wales.

A case of HeV was confirmed in a horse at Chinchilla, Queensland, in 2011, which was the first detection west of the Great Dividing Range. Another case was confirmed in a horse at Macksville, New South Wales, which is the southernmost case detected to date. Prior to 2011, the known detections had occurred on or east of the Great Dividing Range from Cairns to northern New South Wales.

Flying foxes are a natural reservoir of HeV and the closely related Nipah virus. HeV is present in flying fox populations in Australia and Papua New Guinea. Nipah virus is not known to be present in Australia but is present in South East Asia and Indonesia.

The mode of HeV transmission between flying foxes, and 'spillover' from flying foxes to horses, is not fully understood. HeV has been identified in the urine, birthing fluids, placental material and aborted pups of wild flying foxes and in the faeces of experimentally infected flying foxes. The virus has been isolated from urine following natural and experimental infections. The related Nipah virus has been recovered from flying fox urine and saliva in Malaysia.

Flying foxes are mobile animals and HeV should be considered wherever horses and flying foxes are in proximity to each other. Horses are also transported long distances and could be moved within the incubation period from an area where they may have been in contact with flying foxes to an area where flying foxes do not exist.

For further details on the incidents, refer to Appendix 1.

Table 1. Confirmed HeV incidents

Location	Date
Mackay, Queensland	August 1994
Hendra, Queensland	September 1994
Cairns, Queensland	January 1999
Cairns, Queensland	October 2004
Townsville, Queensland	December 2004
Peachester, Queensland	June 2006
Murwillumbah, New South Wales	October 2006
Peachester, Queensland	June 2007
Cairns, Queensland	July 2007
Redlands, Queensland	June 2008
Proserpine, Queensland	July 2008
Cawarral, Queensland	August 2009
Bowen, Queensland	September 2009
Tewantin, Queensland	May 2010
Beaudesert, Queensland	June 2011
Boonah, Queensland	June 2011

Table 1. Continued

Location	Date
Logan Reserve, Queensland	June 2011
Wollongbar, New South Wales	June 2011
Park Ridge, Queensland	July 2011
Macksville, New South Wales	July 2011
Kuranda, Queensland	July 2011
Lismore, New South Wales	July 2011
Hervey Bay, Queensland	July 2011
Boondall, Queensland	July 2011
Chinchilla, Queensland	July 2011
Mullumbimby, New South Wales	July 2011
Ballina, New South Wales	August 2011
South Ballina, New South Wales	August 2011
Mullumbimby, New South Wales	August 2011
Gold Coast hinterland, Queensland	August 2011
North Ballina, New South Wales	August 2011
Beachmere, Queensland	October 2011

- Experimental studies in horses have identified HeV in respiratory secretions, saliva, urine and faeces.
- Polymerase chain reaction (PCR) testing of 'natural' case horses has identified HeV genetic material in blood, nasal secretions and a wide range of body tissues, indicating that HeV virus is likely to be widespread throughout the body and fluids of an infected horse.
- Research conducted by AAHL (in 2009) using the Redlands 2008 HeV isolate demonstrated that by the time a horse is showing clinical HeV signs, HeV virus is systemically widespread throughout the body and body fluids.[2]
- The AAHL research also demonstrated that an HeV infected horse can shed HeV genetic material and therefore potentially excrete HeV through nasal/nasopharyngeal secretions, from two days after exposure to HeV up to and including the time that it shows clinical signs. While some transmission risk exists in the preclinical horse, transmission risk increases with disease progression and is highest terminally and during post-mortem contact.
- The first clinical signs seen during the AAHL research were an increase in body temperature and heart rate and a discomfort or restlessness expressed by weight shifting between legs (both fore and hind limbs). This progressed to depression and other signs already associated with clinical HeV infection.
- Case horses are likely to be maximally infectious at necropsy and infectious virus may persist on surfaces contaminated by body fluids at necropsy for a variable period (up to several days), depending on environmental conditions.
- HeV uses cell surface membrane-bound proteins ephrin-B2 and ephrin-B3 as cellular receptors.

[2] Marsh, GA, Haining, J, Hancock, TJ, Robinson, R, Foord, AJ, Barr, JA, Riddell, S, Heine, HG, White, JR, Crameri, G, Field, HE, Wang, L-F and Middleton, D 2011, 'Experimental infection of horses with Hendra virus/Australia/Horse/2008/Redlands' *Emerging Infectious Diseases* 17(12), DOI: 10.3201/eid1712.111162.

- Ephrin-B2 has widespread cellular distribution, especially in vascular endothelial cells, and ephrin-B3 is more prominent in the central nervous system.
- From the disease pathogenesis perspective, it is reasonable to assume that the underlying virus-induced damage to vascular endothelium, and the subsequent vasculitis, plays a major role in producing the clinical presentation (colic, respiratory, neurological etc.) and relates to the organ system/s sustaining severe and compromising endothelial damage.
- Microscopically, lesions of vascular damage and vasculitis are observed in cases of HeV infection. Technically, these are not clinical signs; however, through the widespread and serious damage to capillary endothelium, they certainly make a large contribution to the development of clinical signs and gross post-mortem changes observed. Consequently, the primary presenting clinical signs in infected horses can vary.
- As the disease progresses, a predominance of neurological and/or respiratory signs tends to be seen.
- The AAHL research using the Redlands 2008 HeV isolate demonstrated only a small genetic change in the virus structure from the original isolate (Hendra 1994).
- The majority of incidents coincide with the period from mid/late pregnancy to early birthing of three of the four Australian flying fox species. This correlation does not necessarily indicate a causal association, but does suggest a biological or ecological basis for 'spillover' from flying foxes to horses.
- The prevalence of infection in individual flying fox populations may vary from year to year, and a reliable method for predicting the high-risk period within this time is not available.
- All properties with HeV cases reported some level of flying fox activity in the vicinity but not necessarily the presence of a roosting colony.
- Index cases (the first confirmed cases) have typically been horses paddocked or kept outside in areas that were attractive to flying foxes. In-contact horses kept in a paddock situation with an index case have been confirmed as being infected on seven occasions to date—Mackay (1994), Proserpine (2008), Bowen (2009) and Boonah, Wollongbar, South Ballina and Beachmere (2011).
- HeV horse-to-horse transmission appears to be more efficient in a stabled situation, with spread between horses occurring in all three stabled situations to date—Hendra (1994), Redlands (2008) and Cawarral (2009). It is possible that HeV may survive on fomites for a period of hours under mild climatic conditions, and that transfer to other horses from contaminated fomites through exposure to contaminated secretions/fluids may occur.
- The three stable situations were initiated by an infected horse being brought into stables after exposure in a paddock or outside yard.
- Horses experimentally infected with the original virus isolate from Hendra (1994) did not transmit the virus to in-contact horses. In this same study, a horse was infected following contact with the urine of an infected cat.[3] It is not known whether urine from an infected cat can transmit infection to other animals or humans.
- Experimentally infected cats and guinea pigs were shown to be susceptible to HeV infection. Experimentally infected mice, rats, rabbits, chickens and dogs did not develop clinical disease. Equivocal neutralising antibody titres were detected in three of four rats and one of two dogs in the study, while rabbits developed unequivocal neutralising antibody titres.[4]

[3] Williamson, MM, Hooper, PT, Selleck, PW, Gleeson, LJ, Daniels, PW, Westbury, HA, Murray, PK 1998, 'Transmission studies of Hendra virus (equine Morbillivirus) in fruit bats, horses and cats', *Australian Veterinary Journal* 76(12): 813–818.

[4] Westbury, HA, Hooper, PT, Selleck, PW, Murray, PK 1995, 'Equine Morbillivirus pneumonia: susceptibility of laboratory animals to the virus', *Australian Veterinary Journal* 72(7):278–279.

- Experimental studies in Canada (2010)[5] showed that the response of pigs to inoculation with large doses of virus ranged from no clinical disease to severe interstitial pneumonia.
- This work has demonstrated that pigs can be infected experimentally, but it does not confirm whether or not pigs can be infected naturally. However, pigs can be infected naturally with the closely related Nipah virus.
- Previous surveillance in commercial piggeries in Queensland indicated no evidence of HeV or Nipah virus infection in pigs.[6]
- In July 2011, test results confirmed the presence of antibodies to HeV in a dog sampled on a property where HeV had been confirmed in horses. It was reported that the dog did not show any clinical signs of illness. No HeV genetic material was detected by PCR in samples collected from the dog on three occasions over a three week period. This was the first reported case of HeV antibody detection in a dog outside of an experimental setting.
- From information available, the incubation period in horses (time from exposure to first signs appearing) falls between 5 and 16 days. The course of illness for fatally infected horses averages a little over 2 days from first signs to death.
- From information about confirmed cases prior to 2011, approximately 25% of horses can survive acute infection and become 'recovered' horses. Epidemiological assessment is continuing in this area.
- The current national policy, AUSVETPLAN Response Policy Brief (Hendra virus infection), is that any horse or other terrestrial animal shown through demonstration of antibodies to be infected with HeV or to have recovered from HeV infection is to be euthanased.
- Seven cases of human infection with HeV have been recorded. All cases had exposure either during necropsy of infected horses or from close contact with respiratory secretions and/or blood from an infected horses. In all cases, HeV had not been considered a diagnosis for the horse at the time and exposure had occurred before the equine case was confirmed as HeV. Four of these people died as a result of HeV infection—a case fatality rate of 57%. Human HeV infection has been associated with contact with an infected horse in the late incubation period while it was asymptomatic.[7]

3.3. Document tracking

This document will be managed by Biosecurity Queensland under the standard operating procedure (Quality Management System).

3.4. Additional assistance

If you require assistance in any area related to HeV, please contact Biosecurity Queensland on **13 25 23** (during business hours) or the Emergency Animal Disease Watch Hotline on **1800 675 888** (24 hours).

[5] Li, M, Embury-Hyatt, C and Weingartl, HM 2010, 'Experimental inoculation study indicates swine as a potential host for Hendra virus', *Veterinary Research* 41:33.

[6] Black, PF, Cronin, JP, Morrissy, CJ and Westbury, HA 2001, 'Serological examination for evidence of infection with Hendra and Nipah viruses in Queensland piggeries', *Australian Veterinary Journal* 76(6): 424–6.

[7] Playford, EG, McCall, B, Smith, G, Slinko, V, Allen, G, Smith, I, Moore, F, Taylor, C, Kung, YH and Field, H 2010, 'Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008', *Emerging Infectious Diseases* 16(2): 219–23.

3.5. Related reference documents

Legislation **www.legislation.qld.gov.au**	*Exotic Diseases in Animals Act 1981*
	Veterinary Surgeons Act 1936
	Workplace Health and Safety Act 1995
	Workplace Health and Safety Regulation 2008
AUSVETPLAN **www.animalhealthaustralia.com.au**	*Decontamination manual*
	Hendra virus response policy brief
	Disposal procedures manual
Biosecurity Queensland guides **www.biosecurity.qld.gov.au**	*Hendra information for horse owners*
	Hendra virus—veterinary practice pack
Workplace Health and Safety Queensland **www.worksafe.qld.gov.au**	*Hendra virus: information for horse properties and other horse related businesses*
	Hendra virus: information for veterinarians
	Hendra virus—information for businesses that dispose of horse carcasses
	Workplace Health and Safety Queensland checklist for managing occupational Hendra virus risks in veterinary practice
	Workplace Health and Safety Queensland checklist for managing Hendra virus risks for horse properties and other horse-related businesses

Articles and reports

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Breed, AC, Breed, MF, Meers, J, and Field, HE 2011, 'Evidence of endemic Hendra virus infection in flying-foxes (*Pteropus conspicillatus*)—implications for disease risk management', *PLoS ONE* 6(12): e28816. doi:10.1371/journal.pone.0028816.

Field H, de Jong C, Melville D, Smith C, Smith I, Broos, A, Kung, Y, McLaughlin, A and Zeddeman, A 2011, 'Hendra virus infection dynamics in Australian fruit bats, *PLoS ONE* 6(12): e28678, doi:10.1371/journal.pone.0028678.

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Field, HE, Breed, AC, Shield, J, Hedlefs, RM, Pittard, K, Pott, B, and Summers, PM 2007, 'Epidemiological perspectives on Hendra virus infection in horses and flying foxes', *Australian Veterinary Journal* 85: 268–70.

Field, H, Schaaf K, Kung, N, Simon, C, Waltisbuhl, D, Hobert, H, Moore, F, Middleton, D, Crook, A, Smith, G, Daniels, P, Glanville, R and Lovell D 2010, 'Hendra virus outbreak with novel clinical features, Australia', *Emerging Infectious Diseases* 16(2): 238–40.

Fogarty, R, Halpin, K, Hyatt, AD, Daszak, P and Mungall, BA 2008, 'Henipavirus susceptibility to environmental variables', *Virus Research* 132.

Hanna, JN, McBride, WJ, Brookes, DL, Shield, J, Taylor, CT, Smith, IL, Craig, SB and Smith, GA 2006, 'Hendra virus infection in a veterinarian', *Medical Journal of Australia* 185(10): 562–4.

Hayman, DT, Wang, LF, Barr, J, Baker, KS, Suu-Ire, R, Broder, CC, Cuningham, AA and Wood, JL 2011, 'Antibodies to Henipavirus or henipa-like viruses in domestic pigs in Ghana, West Africa', *Public Library of Science One* 6(9) e25256.

Hess, MR, Massey, PD, Walker, B, Middleton, DJ and Wright, TM 2011, 'Hendra virus: what do we know?' *NSW Public Health Bulletin* 22(6) 118–122.

Li, M, Embury-Hyatt, C and Weingartl, HM 2010, 'Experimental inoculation study indicates swine as a potential host for Hendra virus', *Veterinary Research* 41: 33.

Marsh, GA, Haining, J, Hancock, TJ, Robinson, R, Foord, AJ, Barr, JA, Riddell, S, Heine, HG, White, JR, Crameri, G, Field, HE, Wang, L-F and Middleton, D 2011, 'Experimental infection of horses with Hendra virus/Australia/Horse/2008/Redlands' *Emerging Infectious Diseases* 17(12), DOI: 10.3201/eid1712.111162.

Middleton, D 2009, *Initial experimental characterisation of HeV (Redland Bay 2008) infection in horses*, CSIRO Australian Animal Health Laboratory (AAHL).

Pallister, J, Middleton, DJ, Wang, LF, Klein, R, Haining, J, Robinson, R, Yamada, M, White, J, Payne, J, Feng, YR, Chan, YP and Broder, CC 2011, 'A recombinant Hendra virus G glycoprotein-based subunit vaccine protects ferrets from lethal Hendra virus challenge', *Vaccine* 29(34): 5623–30.

Playford, EG, McCall, B, Smith, G, Slinko, V, Allen, G, Smith, I, Moore, F, Taylor, C, Kung, YH and Field, H 2010, 'Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008', *Emerging Infectious Diseases* 16(2): 219–23.

Plowright, RK, Foley, P, Field, HE, Dobson, AP, Foley, JE, Eby, P and Daszak, P 2011, 'Urban habituation, ecological connectivity and epidemic dampening: the emergence of Hendra virus from flying foxes (*Pteropus* spp.)', *Proceedings of the Royal Society B: Biological Sciences* doi:10. 1098/rspb.2011.0522.

Westbury, HA, Hooper, PT, Selleck, PW, Murray, PK 1995, 'Equine Morbillivirus pneumonia: susceptibility of laboratory animals to the virus', *Australian Veterinary Journal* 72(7):278–279.

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4. Preparedness planning: information to help formulate HeV infection control plans and procedures

Veterinarians should develop, train in and implement infection control procedures to manage the risks associated with investigating and sampling potential HeV cases. Infection control procedures are currently the primary defence for horses in the pre-clinical phase, where they may excrete HeV but still appear clinically normal.

Sections 4 and 5 of these guidelines provide information that should support development of these plans and procedures, but may not contain all the information needed. Individuals can source extra information to suit their own particular situation. Contact Biosecurity Queensland for technical advice on **13 25 23** (business hours).

4.1. Develop a plan outline

Good preparation for the investigation of potential HeV cases should be undertaken as part of normal practice management and before a veterinarian conducts a field investigation. Plans, procedures, equipment and training are all required to assist the smooth handling of investigations.

An HeV case investigation procedure (see section 5) should be tailored to suit individual veterinary needs so that it can be used to respond quickly and confidently to a situation. Where necessary, the procedure should include information specific to the veterinary practice and the situations they are required to manage.

4.1.1. Summary of steps to consider

The following is the minimum number of steps that need to be considered before investigating a horse with potential HeV infection:

1. Make a business decision whether cases of equine illness will be investigated (or not) and accept that HeV then becomes a risk that must be managed.
2. From the client's initial phone call or enquiry, obtain as much history as possible and make an initial case assessment; know the HeV case definition (see section 4.2 'Case definition'). Take appropriate precautions based on any suspicion of HeV; do not wait for confirmation.
3. Know the notifications and other legal considerations required.
    - There is a legal requirement to notify Biosecurity Queensland on **13 25 23** (business hours) or **1800 675 888** (any time), or by direct contact with a government veterinary officer (see section 4.3 'Notifications and other legal considerations'). There may be individual and practice requirements for notification as well.
4. If HeV is suspected before you enter the property, know the precautions and procedures to follow. These include:
    - workplace health and safety precautions that the veterinary practice agrees must be taken (see section 4.4 'Workplace health and safety precautions')
    - obligations as the veterinary practitioner in control of the workplace to ensure that the risk of injury or illness is minimised for yourself, workers and others who are assisting you (see section 4.4 'Workplace health and safety precautions')
    - the choice of PPE and disinfectants used (see section 4.5 'Biosecurity precautions')
    - entry and exit procedures (see section 4.5.6 'Entry/exit procedures').

5. If you do not suspect HeV before the examination of a horse:
    - know the immediate steps to take to minimise the risk and exposure to yourself and others if there is unplanned contact with an ill horse (see section 4.6 'Unplanned contact with a suspect horse').
6. Develop a sampling protocol.
    - Prepare an HeV sample collection procedure that includes:
        - samples required and the safest methods of collecting them
        - appropriate equipment needed.
    - Prepare an HeV sample dispatch procedure (see section 4.7 'Sampling, dispatch and testing'). This procedure should explain:
        - how to safely pack samples or which couriers will provide this service
        - where to dispatch samples (**Note:** Dispatch HeV samples to a Queensland Government laboratory, NOT a private laboratory)
        - which couriers will transport samples and which couriers provide an out-of-hours service.
7. Prepare biosecurity advice that can be given to clients (see section 4.8 'Biosecurity advice to clients'). This should explain:
    - basic advice for all situations
    - what owners and managers involved with managing the case and the site should do.[8]
8. Prepare advice about disposal of carcasses (see section 4.9 'Carcass disposal'. The fact sheet *Hendra virus—information for businesses that dispose of horse carcasses,* available from www.worksafe.qld.gov.au, may also be helpful). This should detail:
    - the disposal method of choice for the area (deep burial on site if possible)
    - specific advice for owners/contractors to assist safe disposal and to prevent disease spread.
9. Prepare a list of contacts that you will be required to liaise with and record the contact details (see section 4.11 'List of contacts').
10. Accept that a response to HeV may be a team effort and that a number of different people may be involved, all with different responsibilities.
11. Understand your responsibilities regarding media and confidentiality (see section 4.12 'Media and confidentiality').

4.1.2. Training

Any plan developed will require training in its use and application if it is to achieve its purpose.

Once a veterinary practice has developed an HeV case investigation procedure, regular training of all staff in the implementation of the procedure is recommended, as is the keeping of training records.

The use of recommended PPE will require training if PPE is not routinely used. A number of PPE suppliers provide training in correct fitting and use of PPE.

The packaging of samples for laboratory testing may also require training (available from private providers) to ensure diagnostic samples comply with transport requirements. Alternatively, a decision can be made (and recorded in the procedure) to use a courier company that will provide a packing and transport service for such samples.

[8] For more information, please read the fact sheets *Hendra virus: important information for horse owners* and *Information for horse owners* ((in the Hendra virus—veterinary practice pack) available at www.biosecurity.qld.gov.au

4.2. Case definition

There are no pathognomonic signs that define HeV infection in horses. Horses that are infected with HeV have shown variable and often vague clinical signs.

There is, however, a range of clinical signs recorded from positive cases, including some signs that have been common to many positive cases. This necessitates applying professional veterinary judgement to ill horses to decide whether HeV may be involved. Using the following list of clinical signs will help a veterinarian assign a case definition of 'exclusion case' or 'suspect case'.

HeV should be considered where there is acute onset of clinical signs that may include increased body temperature, increased heart rate and rapid progression to death associated with either respiratory and/or neurological signs.

Note: Based on the AAHL research, an elevated temperature and heart rate should be considered as early warning of the possibility of HeV infection.[9] Progression to include other clinical signs, as mentioned below, increases the possibility of HeV infection.

The precautionary principle should be applied at the first indication of clinical illness and also when conducting invasive/aerosol-generating procedures of the respiratory tract and other high-risk procedures (e.g. endoscopy of the upper and lower respiratory tract, dentistry using power floats, necropsy, broncho-alveolar lavage and nasal lavage). The AAHL research suggests that an infected horse can excrete HeV in nasal or nasopharyngeal secretions from two days following exposure to HeV virus, up to and including the time of onset of clinical signs, and that a strongly symptomatic horse poses the greatest transmission risk to other horses and humans through body fluids.[10] Appropriate infection control and general biosecurity measures must be applied to the sampling and management of such horses.

Laboratory testing is required to confirm whether a horse is actually infected with HeV.

As outlined (see section 3.2 'Epidemiology'), HeV has an affinity for endothelial cells and causes systemic vasculitis. The organ/system where the greatest damage occurs would appear to contribute directly to the clinical signs seen.

Professional veterinary interpretation is required to assess if the case under investigation should be described as an 'exclusion' or 'suspect' case. The following signs will help in the assessment.

Common clinical signs:

- acute onset of illness
- increased body temperature
- increased heart rate
- discomfort/weight shifting between legs (both fore and hind limbs)
- depression
- rapid deterioration, usually with respiratory and/or neurological signs.

Some other clinical observations that have been noted include the following.

Respiratory signs, including:

- pulmonary oedema and congestion
- respiratory distress—increased respiratory rates

[9] Marsh, GA, Haining, J, Hancock, TJ, Robinson, R, Foord, AJ, Barr, JA, Riddell, S, Heine, HG, White, JR, Crameri, G, Field, HE, Wang, L-F and Middleton, D 2011, 'Experimental infection of horses with Hendra virus/Australia/Horse/2008/Redlands' *Emerging Infectious Diseases* 17(12), DOI: 10.3201/eid1712.111162.

[10] ibid.

- terminal nasal discharge—can be initially clear progressing to stable white froth and/or stable blood-stained froth
- pulmonary involvement leading to terminal weakness, ataxia and collapse.

Neurological signs, including:

- 'wobbly gait' progressing to ataxia
- altered consciousness—apparent loss of vision in one or both eyes, aimless walking in a dazed state
- head tilting, circling
- muscle twitching—myoclonic spasms have been seen in acutely ill and recovered horses
- urinary incontinence
- recumbency with inability to rise.

Other observations, including:

- previous unexplained horse deaths (**Note:** This is important to check and has been a feature in a number of the incidents to date)
- facial oedema
- facial paralysis and/or a locked jaw
- spasms of the jaw, involuntary chomping
- muscle trembling
- altered gait, high stepping
- anorexia
- congestion of oral mucous membranes
- a high case fatality rate within 48 hours where there are multiple cases
- colic-like symptoms in some cases (generally quiet abdominal sounds on auscultation of the abdomen in pre-terminal cases)
- straining with difficulty passing manure
- stranguria (difficult urination)—seen in several terminal cases in both males and females (Hendra 1994); dribbling urine—seen in some terminal cases (Redlands 2008)
- hot hooves
- bad breath/halitosis
- delayed blood clotting times.

Proximity to flying foxes would support the above signs, though lack of sightings does not preclude HeV.

In most of the recorded infected cases, there has been strong presentation of clinical signs; however, occasional cases have demonstrated a much milder presentation of clinical signs.

From information about the confirmed cases to date, approximately 25% of horses can survive acute infection.

In a paddock situation, HeV disease in horses is more likely to occur in a single sick or dead horse. In paddock situations to date, the majority (65%) have involved one infected horse that died without any in-contact horses becoming infected.

In a stable situation, it appears that HeV has the potential to spread to other horses either through close direct contact with infectious body fluids or excreta, or through indirect contact via contaminated fomites, including human-assisted transfer. Two events in stables (Hendra 1994 and Redlands 2008) and one event on a property comprising multiple small paddocks (Cawarral 2009) have resulted in multiple horses becoming infected. It should be noted that all these events appear to have arisen from a horse initially becoming infected in a paddock or outside yard.

4.2.1. Exclusion case

A horse should be considered an 'exclusion case' if:

- it is showing an unexplained elevated temperature and heart rate
- it is showing any other of the signs listed
- HeV is one of a number of differential diagnoses being considered.

Sampling to exclude HeV is necessary and veterinarians should implement their HeV infection control procedures to investigate and sample these cases.

4.2.2. Suspect case

A horse should be considered a 'suspect case' if:

- it is showing an unexplained elevated temperature and heart rate
- it is showing any other of the signs listed
- there is exposure history, property history or other epidemiological evidence indicative of increased likelihood of being an HeV case
- HeV is a primary diagnosis.

Sampling is essential to confirm the presence or absence of HeV. Veterinarians should implement their HeV infection control procedures to investigate and sample these cases.

4.2.3. Other animals

In July 2011, test results confirmed the presence of antibodies to HeV in a dog sampled on a property where HeV had been confirmed in horses. It was reported that the dog did not show any clinical signs of illness. No HeV genetic material was detected by PCR in samples collected from the dog on three occasions over a three-week period. This was the first reported case of HeV antibody detection in a dog outside of an experimental setting.

A study done in 1995 showed that mice, rats, rabbits, chickens and dogs did not develop any clinical disease following subcutaneous inoculation with HeV. In the same study, cats and guinea pigs became infected and succumbed to the disease. Equivocal neutralising antibody titres were detected in three of four rats and one of two dogs in the study, while rabbits developed unequivocal neutralising antibody titres.[11]

The potential exists for susceptible non-equine domestic species to become infected with HeV and this should be considered as part of the management of HeV incidents.

Biosecurity Queensland will sample susceptible species other than horses for HeV testing, if they have been assessed as having had close contact with a confirmed HeV positive horse.

[11] Westbury, HA, Hooper, PT, Selleck, PW, Murray, PK 1995, 'Equine Morbillivirus pneumonia: susceptibility of laboratory animals to the virus', *Australian Veterinary Journal* 72(7):278–279.

If private veterinarians are considering sampling species other than horses for HeV testing, they should contact Biosecurity Queensland to discuss the case.

Further research is underway in the area of susceptibility and transmission of HeV in non-equine species, including dogs.

4.2.4. Human exposure

Biosecurity Queensland will contact Queensland Health whenever HeV is confirmed or highly suspected as per an agreed notification protocol. Queensland Health will decide whether any people require monitoring and/or medical assistance. To make this assessment, Queensland Health will work with the veterinarian and the horse owner to identify the people they may need to contact.

If any person is concerned about their health, they should seek medical advice and contact their local GP, their nearest Queensland Health Population Health Unit or the Queensland Health 24-hour hotline on **13 HEALTH (13 43 25 84).**

4.2.5. Differential diagnoses

Other causes of acute death in horses include:

- plant poisonings such as Crofton weed poisoning or avocado poisoning—some apparent HeV cases have, in fact, been avocado poisoning and vice versa
- chemical poisonings—paraquat, lead, fluoroacetate, ionophores (e.g. monensin)
- colic
- intoxications (botulism)
- acute bacterial diseases, such as anthrax.

Other causes of respiratory or neurological disease in horses include:

- inhalation pneumonia or purulent bronchopneumonia
- equine herpes virus (neurological strain)
- Murray Valley encephalitis
- exotic viruses such as African horse sickness, equine influenza, Japanese encephalitis, West Nile virus, encephalitides (eastern, western, Venezuelan), hantavirus pulmonary syndrome
- acute septicaemias
- purpura haemorrhagica
- snake bite envenomation
- paralysis tick (*Ixodes holocyclus*).

A more comprehensive list of differential diagnoses can be found in section 5.1.2. ‘Case definition’.

4.3. Notifications and other legal considerations

4.3.1. Legal considerations

HeV is a notifiable disease under both the *Stock Act 1915* and the *Exotic Diseases in Animals Act 1981*. This places an obligation on a veterinarian who suspects, diagnoses or confirms the presence of a notifiable disease (which includes HeV) to notify the nearest government veterinary officer as soon as possible and within 24 hours.

Obligations to notify based on suspicion, diagnosis or confirmation of HeV are also present in the *Veterinary Surgeons Act 1936*.

Whenever Biosecurity Queensland is satisfied or is of the opinion that stronger action is necessary to manage the situation, it may place the premises in quarantine and implement a disease control program using appropriate legislative powers.

4.3.2. Notifications required

When a veterinarian encounters an exclusion or suspect HeV case, a government veterinarian must be notified as soon as possible (there is a legal obligation to do this). If it appears that human illness may be associated with the case, the veterinarian should also include this information when contacting the government veterinarian. Notification is also an opportunity to seek advice.

Notification can be made by contacting one of the following:

- Biosecurity Queensland on **13 25 23** (business hours)
- Emergency Animal Disease Watch Hotline on **1800 675 888** (24 hours).

When a veterinarian makes contact they should identify themselves and clearly state to the person answering the telephone that they are a veterinarian ringing to notify a possible case of HeV.

When notified of possible HeV cases by a veterinarian, Biosecurity Queensland will then consult with the veterinarian to determine an appropriate course of action.

- For both exclusion and suspect cases, this would usually be for the private veterinary practitioner to continue the investigation and submit samples for testing.
- For exceptional cases, Biosecurity Queensland and the investigating veterinarian will make a joint decision on a course of action appropriate to the situation. This may be that the private veterinary practitioner will complete the investigation and submit samples for testing, or it may be that Biosecurity Queensland will investigate.

Biosecurity Queensland will notify the Australian Veterinary Association, Equine Veterinarians Australia and other bodies as appropriate. Notification to industry bodies is normally made only after a positive diagnosis, not in the instance of possible cases (unless there are exceptional circumstances).

4.3.3. Quarantine and other restrictions

Whenever Biosecurity Queensland is of the opinion that stronger action is necessary to manage a suspect or confirmed HeV situation, it may place the premises in quarantine and implement a disease control program. In Queensland, HeV incidents are managed under the *Exotic Diseases in Animals Act 1981*. A private veterinary practitioner does not have the legal powers to quarantine a property but can advise the owner of voluntary actions to implement for managing the immediate situation.

If a decision is made to quarantine the property, Biosecurity Queensland will manage the animal disease control program. Biosecurity Queensland may retain the services of the private veterinary practitioner as part of this response. If this course of action is chosen, Biosecurity Queensland will enter into an agreement with the veterinary practitioner.

If a property is not quarantined, the investigating veterinarian will continue to manage the animal disease investigation. Where HeV is a differential diagnosis, the aim of an investigation is to maintain safety of all people and animals involved, clinically assess the situation, obtain the appropriate samples to help make a definitive diagnosis and give appropriate biosecurity advice to the owner, and report findings.

In addition to any restrictions implemented by Biosecurity Queensland to manage the disease in animals, Queensland Health may implement restrictions or make recommendations to manage the disease or potential disease in people. Queensland Health will work with the veterinarian and the horse or property owner and any other relevant person to identify the people they may need to contact.

If a business or undertaking is involved in an HeV incident, Workplace Health and Safety Queensland may provide advice and/or monitor compliance with workplace health and safety legislation.

If any person has concerns about possible exposure of people to a horse infected with HeV, they should seek medical advice and contact their general practitioner, local hospital emergency department or local public health unit. For general enquiries about HeV infection in humans, call the Queensland Health Hotline on **13 HEALTH (13 43 24 84)**.

4.4. Workplace health and safety precautions

The *Workplace Health and Safety Act 1995* places obligations on people at workplaces for workplace health and safety. The Workplace Health and Safety Regulation 2008 requires serious bodily injuries, work-caused illnesses (including occupationally acquired zoonoses) and dangerous events to be notified to Workplace Health and Safety Queensland.

Note: In 2011 the Queensland Parliament passed the *Work Health and Safety Act 2011* and the Work Health and Safety Regulation 2011. This new legislation will come into force on 1 January 2012. More information about the changes to work health and safety legislation can be found at www.worksafe.qld.gov.au

Veterinarians and practice principals who conduct a business or undertaking, whether as employers, self-employed people or otherwise, have an obligation under the *Workplace Health and Safety Act 1995* to ensure the workplace health and safety of themselves, their workers and others (e.g. veterinary students, clients and carcass disposal contractors). Discharge of the obligation includes:

- providing and maintaining a safe and healthy work environment
- maintaining safe plant
- ensuring the safe use, handling, storage and transport of substances
- ensuring safe systems of work
- providing information, instruction, training and supervision to ensure health and safety.

Veterinarians and practice principals should consider the following workplace health and safety precautions:

- Conduct a risk assessment for HeV and develop a plan for responding to an HeV case with supporting policies, procedures and training.
- Implement a triage system to identify HeV risk factors when taking bookings for horse consultations.
- Routinely assess HeV risks for all horse contact as a standard work practice.

Adopt standard precautions, as developed by the Australian Veterinary Association, for all contact with horses. This includes:

- personal hygiene, including hand hygiene before and after horse contact, between horses and after removing PPE
- PPE including disposable gloves for contact with blood, body fluids, excretions, non-intact skin and mucous membranes, and protective clothing and facial protection where there is a risk of droplets, splashes and sprays of blood and body fluids
- appropriate reprocessing of reusable veterinary equipment and horse gear after use and between horses

- safe handling, transport, storage and disposal of clinical waste (including sharps)
- safe handling, transport, storage and cleaning of contaminated clothing and other laundry
- safe handling, transport, storage and disposal of pathology specimens
- safe handling and disposal of animal excreta and stable manure
- sharps safety (e.g. use of sharps with safety-engineered medical devices)
- stable hygiene and environmental cleaning using appropriate cleaning agents and disinfectants
- adopting standard precautions plus additional airborne precautions for contact with exclusion, suspect or confirmed HeV cases and for high-risk procedures (e.g. necropsy, aerosol-generating procedures involving nasopharyngeal secretions) on clinically normal horses. This includes the PPE as detailed in section 4.5.2
- developing systems for blood/body-fluid spills management and managing accidental blood/body-fluid exposures and sharps injuries
- implementing biosecurity practices (e.g. entry/exit procedures)
- providing a dedicated HeV field kit with appropriate equipment and PPE
- minimising the number of people who have contact with exclusion, suspect, or confirmed HeV cases
- providing advice to owners or other contact people showing signs of ill health at or soon after a disease investigation where HeV is confirmed or highly suspected to seek medical advice and to contact their local Queensland Health Population Health Unit
- ensuring that any potentially infected animal does not pose a risk of infection to other animals or to people. Where disposal occurs on property, this could include ensuring that a disposal option is used that is safe and does not cause environmental harm or contamination. Disposal should be undertaken by people who are aware of the risks and familiar with appropriate disposal methods.

If you consider an exclusion case or a suspect case of HeV, and the horse is on your premises, you should:

- assess zoonotic risks and take steps to manage these risks
- follow the workplace health and safety guidance outlined in your HeV case investigation procedure
- isolate the sick or dead horse from all people, all other horses and all other domestic animals on the premises
- make the necessary notifications and discuss the required case plan with Biosecurity Queensland
- develop a plan to safely manage the situation on your premises, or implement an already agreed site biosecurity plan
- limit human contact with all horses on the site that have had contact with the sick or dead horses until it is resolved that the problem is not HeV or that HeV is no longer present
- send required samples to a government veterinary laboratory for HeV testing (see section 4.7 ‘Sampling, dispatch and testing’)
- seek advice from Biosecurity Queensland about disposal of any dead horses pending sample results
- advise any person who is concerned about their health at any time to seek medical advice.

If an exclusion or suspect case of HeV is identified when visiting other premises in a professional capacity, workplace health and safety obligations continue to exist because the premises becomes the workplace of the attending veterinarians and their staff while they are on site.

At the premises you should:

- assess zoonotic risks and take steps to manage these risks
- follow the workplace health and safety guidance in this document
- consult and cooperate with other people at the premises who may have a workplace health and safety obligation for the matter (e.g. the property owner)
- advise the owner/manager to isolate the sick or dead horse from all people, all other horses and all other pets on the premises
- advise the owner/manager of the development of a plan to handle the situation on the premises
- advise the owner/manager to limit human contact with all other horses on the property that have had contact with the sick or dead horses until it is resolved that the problem is not HeV or that HeV is no longer present on the property
- advise the owner/manager of the zoonotic risks and how to protect against infection, including personal hygiene (including hand hygiene) and the use of PPE
- ensure the workplace health and safety of any person at the premises who assists you with a veterinary assessment or procedure (e.g. restraining the horse) and ensure that they understand your instructions for their workplace health and safety
- consider using a trained veterinary professional to assist you (e.g. veterinary nurse) rather than using the horse owner or carer
- make the necessary notifications and discuss the required case plan with Biosecurity Queensland
- advise the owner/manager of suitable PPE to be used by those people required to have contact with the horse
- collect and send required samples to a government veterinary laboratory for HeV testing
- advise the owner/manager to seek advice from Biosecurity Queensland about disposal of any dead horses pending sample results
- advise any person who is concerned about their health at any time to seek medical advice.

If Biosecurity Queensland places a property under quarantine for HeV, that property becomes a workplace of Biosecurity Queensland. The property owner may also have workplace responsibilities (e.g. if running a business such as a riding school). Biosecurity Queensland will work closely with the owner/manager to discharge the workplace health and safety obligations while the property remains under quarantine and will determine what activities take place on that property. For all other non-quarantined properties, workplace health and safety responsibilities remain with the owner/manager/carer and with the private veterinary practitioner and Biosecurity Queensland if they enter the property in a business capacity.

For more information, contact Workplace Health and Safety Queensland on **1300 369 915** or visit the Workplace Health and Safety Queensland website at **www.worksafe.qld.gov.au**

4.5. Biosecurity precautions

4.5.1. Personal safety and prevention of zoonotic risk

Human infection with HeV has a high case fatality rate. Human infections have occurred from close contact with HeV infected horses (both live horses and dead horses at necropsy examination), so great care is needed to ensure the personal safety of the veterianarian and others who may be assisting.

Human HeV infection has been associated with close contact with an infected horse in the late incubation period while it was asymptomatic.[12]

A major problem has been that HeV is often diagnosed retrospectively in horses (i.e. after human exposure has occurred). **This reinforces both the need to implement these guidelines on suspicion of HeV, rather than waiting for confirmation,** and the importance of early diagnostic consideration of HeV.

It also reinforces the importance of developing appropriate infection control procedures to use in day-to-day situations. Appropriate infection control procedures currently provide the primary defence for horses in the pre-clinical phase, where they may excrete HeV but still appear clinically normal.

In particular, perform hand hygiene and treat tissues, blood and other body fluids (especially respiratory and nasal secretions and saliva) and excretions as potentially infectious. Take appropriate precautions to prevent any direct contact with, splashback of or accidental inoculation with these body fluids or excretions.

The *Medical Journal of Australia* contains an article titled 'Hendra virus infection in a veterinarian'[13] detailing a case where a veterinarian became infected with HeV while performing a necropsy on an HeV infected horse without taking adequate precautions.

The article 'Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008' was published in *Emerging Infectious Diseases*.[14] It details the HeV infection of two veterinary clinic staff.

4.5.2. Personal protective equipment (PPE)

It is recommended that veterinarians discuss their specific safety needs with a supplier of safety equipment. Veterinarians will receive expert advice and be provided with a selection of products appropriate for individual situations from the vast array of safety equipment products available.

PPE forms a part of the risk management approach to personal safety. Other factors, such as HeV planning and preparedness and managing exposure to HeV risks, also play their part. PPE should be combined with these to provide the best protection possible.

The PPE suitable for use with HeV may not be used routinely in everyday veterinary practice. You should source PPE ahead of time and receive training in its correct use.

Note: Biosecurity Queensland does not have specialist PPE trainers and sources its PPE and training from commercial PPE providers to meet the various demands of emergency animal disease response.

The PPE selected is intended to form a barrier between the person and the virus and should include gloves, particulate respirator, eye protection, overalls and impervious boots.

The following PPE is used by Biosecurity Queensland officers when investigating potential HeV situations to collect samples to test for HeV:

- impervious rubber boots

[12] Playford, EG, McCall, B, Smith, G, Slinko, V, Allen, G, Smith, I, Moore, F, Taylor, C, Kung, YH and Field, H 2010, 'Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008', *Emerging Infectious Diseases* 16(2): 219–23.

[13] Hanna, JN, McBride, WJ, Brookes, DL, Shield, J, Taylor, CT, Smith, IL, Craig, SB and Smith, GA 2006, 'Hendra virus infection in a veterinarian', *Medical Journal of Australia* 185 (10): 562–4.

[14] Playford, EG, McCall, B, Smith, G, Slinko, V, Allen, G, Smith, I, Moore, F, Taylor, C, Kung, YH and Field, H 2010, 'Human Hendra virus encephalitis associated with equine outbreak, Australia, 2008', *Emerging Infectious Diseases* 16(2): 219–23.

- splash-proof overalls (long sleeves to prevent contamination of skin where there may be cuts and abrasions) or cotton or disposable overalls with impervious or splash-proof apron
- disposable impermeable gloves (nitrile gloves recommended), double-gloved
- face shield or safety eyewear (to protect against facial splashing)
- a particulate respirator. **The minimum level of respiratory protection when investigating a potential case is a P2** (also known as N95) respirator.

Where Biosecurity Queensland officers assess that a higher level of risk exists or a horse is known HeV positive, the standard of PPE is increased accordingly.

Note: Splash-proof recommendation is used for PPE as this usually means the items are lighter and better suited to hotter conditions that may be faced during investigation. Impervious PPE, particularly impervious overalls/suits, need to be used with great care as there is a real risk of rapidly overheating (i.e. less than 20 minutes), particularly if used in direct sunlight.

Using PPE can create significant heat stress issues. The risk of heat stress should be managed (e.g. by ensuring adequate hydration before commencing work, scheduling work times to avoid the hottest part of the day, using cool clothing and cooling scarves and vests, drinking fluids, using portable shade, taking frequent rest breaks in cool areas, rotating teams or using a buddy system, and knowing the signs of heat stress and stopping work if these signs start to develop).

Ensure you have adequate PPE supplies for repeat visits and for those assisting you.

Always perform hand hygiene after removing PPE.

4.5.3. Respiratory protection

It is recommended that veterinarians discuss their specific respiratory protection needs with a supplier of safety equipment.

After due investigation, Biosecurity Queensland has developed a work instruction standard for its officers. It states that the minimum level of respiratory protection for investigating potential HeV situations will be at P2 particulate protection level. This is supplied either by a disposable half-face P2 particulate respirator, or use of P2 filters on either a half-face respirator, a full-face respirator, or a powered air purifying respirator (PAPR).

Note: There are many different respirators providing respiratory protection for many different situations. For more information about appropriate respiratory protection, we recommend that private veterinary practitioners contact a supplier of safety products.

Biosecurity Queensland officers are supported if they assess that a higher level of protection is needed (e.g. P3 or N99 particulate level protection), and suitable equipment and other PPE to provide this level of protection is supplied.

Note: A standard surgical facemask is not a respirator and will not provide respiratory protection. Surgical masks should not be worn for exclusion, suspect or confirmed HeV cases (refer to Australian Standard AS 1715 for information on implementing a respiratory protection program). A dust mask will not filter bioaerosols and is also unsuitable.

The following comments in this section are drawn from a range of existing safety recommendations and previous experience. They are provided in the interests of sharing information.

Biosecurity Queensland recommends that veterinarians discuss their specific safety needs with a supplier of safety equipment. Veterinarians will receive expert advice and be provided with a selection of products appropriate for individual situations from the vast array of safety equipment products available.

Disposable half-face respirators with exhalation valves may be more comfortable to wear if they need to be worn for prolonged periods.

Negative pressure (e.g. disposable) respirators are only suitable for clean-shaven people. They depend on an effective seal with the skin of the face and will not provide proper protection if the wearer has facial hair including a beard, moustache, side burns or stubble growth. Hence, these people should not take part in any investigations unless different respiratory protection is used (e.g. a PAPR that draws air in through a filter and supplies it to a hood worn over the head). Both P2 and P3 level particulate filters can be used with a PAPR. The PAPR device can also be used to provide a higher level of protection for aerosol-generating procedures and a higher level of comfort in hot environments.

A half-face respirator cannot supply P3 level particulate protection even if P3 or N99 particulate filters are fitted. P3 level particulate protection can only be achieved using a full-face, negative pressure respirator or a PAPR.

4.5.4. Training requirements for PPE use

Commercial suppliers of PPE equipment and training can equip and train in correct donning and doffing procedure (putting on and taking off PPE), fit checking for respiratory protection and respiratory fit testing.

- Fit checking allows the selected respirator to be donned correctly and fit checked to ensure it has sealed on the face correctly. A fit check should be performed each time a respirator is donned. Do not handle or touch the respirator once it has been correctly positioned on the face, as this may modify the facial seal.
- Respirator fit testing is a method of determining the brand and size of respirator that is best suited to an individual's facial characteristics, and can be performed using qualitative or quantitative test methods. Veterinarians who regularly care for horses should conduct respirator fit testing to ensure that they and their workers know which respirator will best protect them if an HeV investigation occurs.

It is recommended that all records of PPE training and results of fit testing be retained by the practice.

4.5.5. Disinfectants

Specific testing of disinfectant compounds against HeV has not been conducted.

From the AUSVETPLAN decontamination manual[15], HeV is a member of Category A viruses. This category of viruses contain a lipid envelope.

Disinfectants named here have been drawn from the list that are known to have either effect against all viruses or specific action against Category A viruses.

Disinfectants include:

- soaps and detergents
- Virkon®
- hypochlorites
- iodophors/iodine
- biguanidines (e.g. chlorhexidine)
- quaternary ammonium compounds.

Others are named in AUSVETPLAN but these require special precautions for their safe use and are not listed here.

The use of any disinfectants that are hazardous substances must be in accordance with the hazardous substances provisions of the Workplace Health and Safety Regulation 2008.

[15] www.animalhealth.com.au

4.5.6. Entry/exit procedures

Establishing entry/exit procedures, whether for routine property visits or for possible HeV investigations, provides a clear process to apply relevant infection control procedures, including PPE, to the situation so that personal safety and disease control are managed.

The broad principles are:

- Define the edge of the hot or dirty zone (i.e. the zone where HeV contamination may be present).
- Select a site at this edge that has good access from the cold or clean area.
- At this site establish an entry/exit decontamination site. This site allows you to prepare safely in the cold zone, including donning of PPE, preparing sampling equipment, preparing disinfectant solutions etc.
- Only enter the hot zone when you are fully prepared.
- The arrangement of this site then allows you to exit through a decontamination process that protects personal safety and prevents disease spread.
- If repeat visits are likely or if other colleagues may visit, mark the site clearly so the same site is used each time. This prevents other people setting up on potentially contaminated ground.
- Recommend this process to other people who may need to access the hot zone to manage the welfare of horses held in there.

The more detailed outline for entry and exit procedures in section 5 draws heavily from the procedures used by Biosecurity Queensland officers. If you would like more advice on this area, please contact Biosecurity Queensland on **13 25 23**.

4.6. Unplanned contact with a suspect horse

This risk should be addressed in preparedness planning.

To minimise exposure risk, it is strongly recommended a dedicated field kit appropriate for managing possible HeV cases (including PPE, cleaning agents, disinfectants, sampling equipment and waste disposal bags) is compiled and available to veterinary practitioners who have unplanned contact with an ill horse. This will provide veterinarians with ready access to the equipment needed to adequately protect themselves and others against exposure in situations where an HeV situation arises with no prior suspicion or warning.

If HeV is suspected during routine work where no special precautions have been taken, follow these steps:

- Minimise exposure. Withdraw to a safe area and instruct accompanying people to do the same.
- Assess the degree of exposure and use soap and water to wash off contamination—shower if necessary (where this is possible).
- If exposure has occurred, seek prompt medical advice and also contact the local Queensland Health Population Health Unit—obtain the number of the local unit from the telephone book and have it handy at all times.
- Notify Biosecurity Queensland of the case.

If the veterinarian is in a position to proceed with the case, follow these steps:

- Assess whether it is safe (for veterinarians and assistants) to re-enter the ‘dirty’ area to sample the horse/s. Only if it is safe to proceed and the level of PPE is adequate, continue with the investigation as per the HeV case investigation procedure.
- Seek advice from Biosecurity Queensland as required.

4.7. Sampling, dispatch and testing

Note: It is the veterinarian's responsibility to meet the cost of forwarding the samples to a Biosecurity Queensland veterinary laboratory. Biosecurity Queensland will meet all laboratory testing costs to test the samples for HeV in diagnostic cases (suspect or exclusion cases).

Private veterinary practitioners should make the final decision about whether to collect samples and submit them for laboratory testing with reference to these guidelines and, where required, obtain advice from Biosecurity Queensland.

All HeV testing conducted by Biosecurity Queensland is conducted at the Biosecurity Sciences Laboratory (BSL) at Coopers Plains. Submissions can be made to Biosecurity Queensland's other laboratories in Townsville and Toowoomba and samples will be transported to BSL for testing. Direct submission to BSL will achieve the shortest turnaround times.

If HeV is a differential diagnosis then it should be excluded by laboratory testing before samples are sent to private laboratories for diagnostic testing for other diseases.

Biosecurity Queensland recommends veterinarians phone ahead to advise the laboratory of the impending submission so appropriate arrangements to facilitate testing can be made, especially outside of business hours. See section 4.11 for contact details.

4.7.1. Preferred samples and sample equipment

Take stringent precautions for yourself and anyone assisting you while conducting any sampling on possible HeV cases. These precautions should be outlined in the HeV case investigation procedure (see section 5 for more detail).

Samples may need to be taken from both live and dead horses, and therefore veterinary assessment of the risks associated with taking samples is required. Veterinary practitioners need to use their professional judgement as to what is safe and appropriate in each situation and proceed accordingly.

Dead horses can be sampled adequately for HeV testing without conducting a complete necropsy. Necropsy on an HeV infected horse is a very high risk activity because the horse is maximally infectious at this time, and should only be undertaken by a person who is suitably experienced and knowledgeable about how to manage exposure to HeV and how to use the relevant PPE.

Only take samples if your risk of exposure and that of others, such as anyone assisting you, can be adequately managed.

Biosecurity Queensland recommends that multiple sites be sampled from each horse as this will raise the diagnostic sensitivity of the sampling procedure as a whole.

Consider taking duplicate samples to allow further diagnostic work if the samples are HeV negative.

Preferred samples for both live and dead horses include the following (veterinarians should choose the appropriate samples to take to suit the situation from this list):

- blood sample
  - 1 x 10 mL of whole blood in a plain tube
  - 1 x 10 mL of blood in EDTA
  - 1 x 10 mL of blood in lithium heparin
- nasal swab
- oral swab (taken from the surface of the tongue)
- rectal mucosal swab (not a faecal swab)
- urine swab (taken from the ground immediately post-urination).

Note: Mid-stream collection requires care due to the increased risk associated with sampling and should only be performed if the risk to personal safety is adequately managed and suitable PPE is worn.

  - **Swabs should preferably be transported in virus transport medium (VTM). Saline can be used if VTM is not available.**

- body tissues—AAHL has recommended the following tissue samples from dead horses may be useful, but only where collection risks to the veterinarians and assisting persons can be properly managed, including any release of free blood during the procedure, and if it is safe to do so. Collection of these samples will raise the overall test sensitivity for HeV when combined with swabs. Post-mortem sampling should be limited to these samples until HeV has been ruled out. This may be of particular value where the carcass is being held pending a full necropsy for insurance purposes
  - submandibular lymph node
  - blood clot obtained by cutting down onto the jugular vein.

Note: If sampling opportunity is limited, the most valuable samples are a nasal swab and whole blood in EDTA and/or lithium heparin.

For exclusion and suspect cases, HeV should be excluded as a potential cause before any necropsy for insurance purposes takes place. If the horse is insured, the insurance company needs to be informed that limited samples will be taken until HeV is ruled out as a possible cause.

4.7.2. Sample dispatch

There are packaging requirements that must be met to transport biological samples by road, rail or air. Requirements apply to all samples sent by private veterinary practitioners to a laboratory. For example, International Air Transport Association (IATA) Packing Instructions 650 and 602 apply to many of the samples sent by veterinarians. More information can be obtained from the internet by entering 'IATA packing instructions' into an internet search engine.

Training from an accredited provider is required for the packing of some categories of samples. This would include most samples from HeV exclusion and suspect cases. Training can be obtained from private providers.

Some courier companies will provide a complete service (i.e. they will come to a veterinary practice, pack and dispatch the samples correctly). It is recommended that veterinary practices establish an account with the courier service of their choice so that samples for HeV testing can be dispatched for testing without delay. A previously established account is usually required for a courier service to make a collection.

Notes on dispatch of samples:

- Dispatch the samples to one of the government veterinary laboratories listed in section 4.11 in the shortest time possible. Private veterinary laboratories do not conduct HeV exclusion testing. Direct submission to the Biosecurity Sciences Laboratory (BSL) will achieve the shortest turnaround times.
- Call ahead to notify the laboratory that HeV samples are coming.
- The veterinarian will be responsible for the dispatch of samples and cost of transport to the laboratory.

  Note: A government laboratory will provide diagnostic HeV testing free of charge but this is unlikely to identify a cause if samples are HeV negative.

- Fill out a specimen advice sheet (SAS) with all details, including a thorough history—this paperwork is essential. **Place the SAS outside the sample package** so it can be read before the package is opened.
- A copy of the SAS is available from the Biosecurity Queensland website (www.biosecurity.qld.gov.au, search for 'GEN-008 Specimen advice sheet').
- Clearly write **HENDRA VIRUS EXCLUSION** on the SAS.
- Note that private laboratories will forward samples to a government laboratory if necessary; however, this will add more time until results are available and may incur additional costs. This also makes the private laboratory the submitter of the samples and the government laboratory will report results back to them as the submitter. This may result in delayed reporting to the submitting veterinarian and should be considered as part of the sample submission process.
- If within easy driving distance of a Biosecurity Queensland veterinary laboratory (located in Brisbane, Toowoomba and Townsville), an option is to pack the samples safely (make sure the samples are contained within an appropriate second or outer container to prevent spillages) and drive them to the laboratory. Before departure, notify the laboratory that these samples will be arriving.
- Before enlisting a client to deliver samples to a laboratory, veterinarians should check that the stress of a suspected HeV case is not affecting their client's capability to drive safely.
- Samples should be kept refrigerated, NOT frozen. It is important to ensure the cold chain is maintained during transport to preserve the integrity of the samples.

4.7.3. Laboratory testing

There are several types of laboratory tests for HeV. The main tests utilised are:

Polymerase chain reaction (PCR) test

- Detects the direct presence of genetic material (virus) in a sample
- Can detect live and dead virus but cannot differentiate between the two
- Most useful early in the clinical course of disease
- Typically one round of testing is run on each weekday at BSL. This is usually commenced at 2 pm. More frequent testing rounds may be conducted in response to increased demand
- Results are usually reported to the submitter within one to two working days of receiving the samples at BSL

Enzyme linked immunosorbent assay (ELISA)

- Indirectly detects the presence of HeV antibodies in a sample
- Regarded as a screening test. A negative ELISA result is a reliable indicator that a horse has not been previously infected; a positive ELISA result is not always a reliable indicator that a horse has been infected
- Samples that do not return a clear ELISA negative result will require additional testing

Virus neutralisation test (VNT)

- Directly detects the presence of HeV antibodies in a sample
- The test involves mixing the blood sample with live virus to see if virus is neutralised by antibodies present in the sample. This test must be conducted under high-level biocontainment and is undertaken at AAHL

- Any samples that do not return a clear ELISA negative result will have a VNT run
- This test may take up to two weeks to complete
- This test remains the gold standard for detection of an antibody response to HeV infection

4.7.4. Urgency of HeV testing for horses

Urgent testing for HeV may be undertaken under certain circumstances.

If urgent testing is requested during business hours, veterinarians should contact the duty pathologist at the Biosecurity Queensland laboratory where samples are being sent to discuss the situation. See section 4.11 for contact details.

If urgent testing is requested outside of normal business hours, veterinarians should contact the Emergency Animal Disease Watch Hotline **1800 675 888** and discuss the situation with the on-call Biosecurity Queensland veterinary officer.

The decision to conduct urgent HeV testing is made following discussion between the submitter and relevant Biosecurity Queensland staff. This may include the on-call Biosecurity Queensland veterinary officer and the on-duty pathologist.

Requests for urgent testing will be assessed on a case-by-case basis.

Reasons that may necessitate urgent testing for HeV include:

- significant human exposure to body fluids of suspect horse/s
- the exposure of large numbers of animals to body fluids of suspect horse/s.

4.8. Biosecurity advice to clients

Advice primarily relates to maintaining the health, safety and welfare of people associated with horses being investigated for HeV and of other animals on the same premises.

Useful reference sources available at www.biosecurity.qld.gov.au are the fact sheets *Hendra virus: important information for horse owners and Information for horse owners* (in the Hendra virus—veterinary practice pack).

It is important to advise the client of the zoonotic potential of HeV and the steps they can take to manage the risk of exposure to themselves and others.

If HeV is highly suspected and potential human exposure has already occurred, clients should contact their general practitioner, local hospital emergency department or local public health unit.

Biosecurity Queensland will contact Queensland Health whenever HeV is confirmed or highly suspected. Queensland Health will decide whether any people require monitoring and/or medical assistance. To make this assessment, Queensland Health will work with the veterinarian and the horse owner to identify the people they may need to contact.

Advice can include the following:

- Isolate sick or dead horses from other horses, people and all other animals (including pets). It is good biosecurity practice to move suspect horses away from external fence lines where other people or animals may have access to them.
- Isolate and minimise contact with any animals that have been in close contact with the sick or dead horses.
- Conduct only the minimum maintenance needs of all horses/sick animals on the property and limit human contact with all horses on the property.

- Provide instruction on the correct use of PPE if contact is absolutely necessary with sick/dead horses and their excreta, and/or other animals where exposure to blood and other body fluids (including saliva and urine), faeces, and aerosols or droplets from coughing/sneezing could occur.
- Maintain a high standard of personal hygiene, including covering cuts, frequent washing of hands and exposed surfaces with soap and water.
- Stop or limit horse movements on and off the property.
- Stop or limit movements of horse products (such as manure) and equipment (such as tack, dental equipment) off the property.
- Stop or limit visiting horse practitioners (such as farriers or equine dentists).
- When disposing of a dead horse, inform the horse carcass disposal contractor that the horse has been tested for HeV and that precautions should be taken.
- Seek medical advice if at all concerned with personal health issues.
- Costs associated with disposal and ongoing care of remaining horses are treated as normal costs and paid by the owner.
- Costs of packaging and transport of samples to a government laboratory are the responsibility of the submitting veterinarian.
- Costs of conducting the laboratory testing are met by government.
- It may take up to several days to get a result from testing samples.
- References for biosecurity advice are *Hendra virus: information for horse properties and other horse-related businesses* and *Hendra virus: information for businesses that dispose of horse carcasses*, available from the Workplace Health and Safety Queensland website (www.worksafe.qld.gov.au). Additionally, the Biosecurity Queensland website has valuable horse and HeV-related information and products (www.biosecurity.qld.gov.au).

4.9. Carcass disposal

If a carcass is held until the results of the investigation are known, the owner or person in charge remains responsible for the disposal. The owner or person in charge can dispose of the carcass using their normal methods if HeV is not diagnosed or not suspected.

Biosecurity Queensland will provide advice on the disposal of a carcass that has tested HeV positive.

If a carcass is to be disposed of before results of the investigation are known, the owner or person in charge is responsible for the disposal. Both this person and the attending veterinarian have an obligation to ensure any potentially infectious animal does not pose a risk of infection to other animals or people and does not cause environmental contamination.

Where HeV is suspected or diagnosed, care will be required in the disposal of the carcass. The following information may assist this process:

- Isolate the carcass from all people and other animals until a disposal method is finalised and can be undertaken safely.
- Disposal options include deep burial on property, burning on property or transport off the property for disposal, for example, to a landfill site.
- Deep burial on the property is the option of choice, and preferably where the carcass is lying so the carcass does not have to be moved.
- Burning on property would mainly be by pyre burning (i.e. the carcass is put on a fire built above ground).

- Dispose of the intact carcass (do not dismember).
- Transport off the site for disposal will require prior planning and coordination.

Note: Costs associated with the disposal of horses are considered as costs to be covered by the owner of the horse.

4.9.1. Steps common to all methods of carcass disposal

- People physically handling the carcass during the process should wear PPE for close contact with a suspect horse.
- Machinery operators should wear sufficient PPE to protect themselves against possible exposure (e.g. splashes of body fluids and from aerosols if generated).
- If machinery is used, the machinery operator should outline the workplace health and safety requirements with respect to the use of the machinery to all people on site.
- Treat all body fluids and excreta with caution.
- Any ground area where body fluids have spilled can be disinfected (using one of the disinfectants listed in section 4.5.5 'Disinfectants') by wetting the soil thoroughly to an area and depth equal to that of the spillage. Alternatively, the layer of contaminated soil can be removed and placed in the burial pit, on the pyre or sent with the carcass off site.
- If the carcass has to be moved, spillage of body fluids or excreta will need to be managed. Enclose the head in a strong plastic bag and tie this off around the neck to help contain fluids. After the carcass is moved, all spillage should be dealt with through disinfection or removed and disposed of as above.
- If cleaning and disinfecting sites, avoiding creating splashes and aerosols for personal safety.
- Suitable disinfectants include soaps and detergents, Virkon®, hypochlorites, iodophors/iodine, biguanidines (e.g. chlorhexidine) and quaternary ammonium compounds. Note that many disinfectants have reduced activity in the presence of organic matter.
- Any part of machinery and equipment that comes in direct contact with the carcass or with body fluids or excreta should be cleaned and disinfected. Avoid splashes and aerosols (do not use high-pressure hoses) when cleaning equipment used for disposal.
- Perform hand hygiene after carcass disposal.

All people should disinfect off through the property's exit point.

4.9.2. Disposal by burial on site

- A minimum depth of hole/trench of 2 metres without striking the water table is recommended.
- Do not bury next to a water course where flooding could expose the carcass.
- A trench is easier to work with as the carcass can be pushed in over the side, especially if the trench is built next to the carcass.
- The machinery operator may be able to provide advice on which is preferable for the location—a trench or hole.
- The aim is to bury with a minimum covering of soil over the carcass of 2 metres. This contains fluids and odours and also prevents animals scavenging on the carcass.

Note: Take normal precautions for animals destroyed with barbiturate solutions to minimise the risk of animals scavenging on the carcass.

4.9.3. Disposal by burning

- Pyre burning may require a permit issued by the local fire authority. A permit will be refused if the fire presents a safety concern to the community.
- Pyre burning is probably unsuitable for smaller properties due to community concerns, lack of fuel and possible fire danger to other properties.
- A large amount of fuel will be needed. AUSVETPLAN states: 'Carcasses can be completely consumed using dry wood alone at the rate of 1.5 tonnes for a 500 kilogram adult bovine or 1.5 tonnes of coal briquettes or equivalent combinations. For multiple carcasses, the amount of fuel may be reduced to 1.0 tonnes per adult bovine because of economies of scale. Straw and liquid fuels are required to start the burn.'
- For best efficiency when building a pyre, it is essential to build air channels at the bottom of the pyre to let air circulate into the bottom of the fire.

4.9.4. Transport off site for disposal

Planning and co-ordination is required.

- Make contact with the receiving entity to ensure they agree to receive the carcass and dispose of it.
- Arrange bio-secure transport (transport that will not leak body fluids or expose people or horses to the carcass.
- Arrange machinery to load the carcass into this transport.
- Manage body fluids.
- Ensure management of the carcass at the receiving end can be done safely.
- The most likely destination will be a registered landfill.

See chapter 3 of the AUSVETPLAN disposal manual.[16]

If unsure of disposal, isolate the carcass and contact Biosecurity Queensland on **13 25 23** or, if necessary, call the Emergency Animal Disease Watch Hotline on **1800 675 888**.

4.10. Downtime

Personal downtime refers to the time that should be spent away from other animals to prevent possible spread of HeV. It refers to the time taken to complete a series of actions more than a definitive period of time. It is recommended that there is no contact, or only minimal contact, with other animals or people until the following actions are completed:

- Wash exposed areas of skin thoroughly with soap and water.
- Remove and wash dirty clothes in a separate hot wash cycle with detergent (avoid re-contamination when doing this). Do not wash potentially contaminated clothing with other household laundry.
- Take a hot shower with shampoo and soap.
- Dress in clean clothes.
- Put on clean footwear or footwear not worn in the dirty area.
- If HeV is confirmed or highly suspected and potential human exposure has already occurred, seek medical advice and also contact the local Queensland Health Population Health Unit.

Once this has been completed, normal work can be resumed.

[16] www.animalhealth.com.au

Equipment downtime refers to the time taken to ensure any equipment used or taken into the dirty area is safe and does not pose a risk of disease transmission. Where possible, use disposable equipment in the dirty area. This equipment can be double-bagged or otherwise sealed safely and held until results are known. If negative, treat as normal waste. If positive, notify Biosecurity Queensland (on **13 25 23**) to discuss disposal/decontamination options.

Equipment to be reused on other animals must be decontaminated. Circumstantial evidence indicates that equipment can act as a fomite and transfer HeV infection between horses.

- Most of this equipment should have been decontaminated during exit of the dirty area. Double check for any remaining organic material and repeat the decontamination process if present.
- Wear PPE when decontaminating equipment, avoid generating aerosols and splashes and wash hands after removing PPE.
- Guidelines from infection control practices in human medicine require equipment to be cleaned with detergent and water prior to soaking in a disinfectant (i.e. the equipment is not to be scrubbed or dipped in the disinfectant without prior cleaning). The rationale is that without prior cleaning, the disinfectant may be unable to penetrate through the organic matter to adequately disinfect the surface. Also, some disinfectants (e.g. sodium hypochlorite) are less effective in the presence of organic matter or 'fix' the organic matter onto the surface (e.g. aldehydes).
- Standards for cleaning, disinfecting and sterilising equipment are set down in Australian Standards available from Standards Australia (www.standards.org.au).
- Equipment that cannot be properly decontaminated on the premises by cleaning and disinfecting should be taken off the premises double-bagged or otherwise sealed. If possible, leave equipment sealed until results are known. If negative, clean as per practice routine.
- If positive, or if equipment cannot be isolated for this long, then the person cleaning should don PPE, remove equipment from its sealed container, clean with detergent and water and complete the process with a recommended disinfectant.
- Note that long-term contact with some of the recommended disinfectants could cause harm to the equipment. Leave in contact with the disinfectant for the recommended time as per label directions and then wash off.
- Check your vehicle for degree of exposure to contaminated items and decontaminate using a recommended disinfectant. Do not forget the steering wheel, door handles, and floor mat.
- Seek advice from Biosecurity Queensland as required.

When equipment has completed this process, it can be reused.

4.11. List of contacts

It is recommended that each practice develop a list of key contacts that may be of assistance in the management of potential HeV infection in horses.

The Chief Veterinary Officer will keep the Australian Veterinary Association, Equine Veterinarians Australia and other appropriate bodies updated and will notify them of significant events as soon as possible so that veterinarians can make informed decisions during their normal work routine.

Biosecurity Queensland
www.biosecurity.qld.gov.au
13 25 23 (business hours)
Emergency Animal Disease Watch Hotline 1800 675 888 (anytime)

Veterinary laboratories
Dispatch samples to one of the following laboratories (direct submission to BSL will achieve the shortest turnaround times). Call ahead to notify that samples are coming.

Biosecurity Sciences Laboratory (BSL)
Health and Food Sciences Precinct
Specimen receipt (Loading Block 12)
39 Kessels Road, Coopers Plains Qld 4108
(07) 3276 6062
Email: bslclo@deedi.qld.gov.au

Tropical and Aquatic Animal Health Laboratory (TAAHL)
39 Abbott Street (entry off Lakeside Drive)
Oonoonba Qld 4811
(07) 4760 1524

Animal Disease Surveillance Laboratory
203 Tor Street
Toowoomba Qld 4350
(07) 4688 1351

Queensland Health
www.health.qld.gov.au
13 HEALTH (13 43 25 84)
Local public health units are listed on the Queensland Health website at **www.health.qld.gov.au/cdcg**

Workplace Health and Safety Queensland
www.worksafe.qld.gov.au
1300 369 915

4.12. Media and confidentiality

4.12.1. Media

It is important that any cases of an HeV disease are openly and accurately communicated to the public.

Any media enquiries should be directed to Biosecurity Queensland's media unit (via **13 25 23**). This allows a consistent approach to be taken by people who have the best access to all information about the overall situation.

It is also recommended that all media approaches to non-departmental government officers be directed to Biosecurity Queensland's media unit.

HeV investigations and responses generate media interest. Investigating veterinarians may be asked for a public comment. The investigating veterinarian has the right to refuse to comment. If they do choose to comment, it is recommended that only facts are presented, that they are not drawn into conjecture and that they comment only on the part of the operation they were directly involved in. The Australian Veterinary Association is able to provide advice to private practitioners on handling media interviews.

4.12.2. Confidentiality

Normal confidentiality provisions apply in the management of HeV incidents. HeV can generate considerable media interest and any statement made should respect the normal confidentiality provisions expected by clients, patients, staff and others involved.

4.13. Closing the case

Closing any case where a veterinarian has elected to test a horse for HeV will require interpretation of laboratory results (if available) and exercising professional judgement.

Negative laboratory results alone may not be sufficient grounds to close the case. Interpretation of the results, in combination with the history and present situation, will most likely be required when making the assessment to close a case.

Conclusive diagnosis of another cause of the illness can close the case.

Up to 25% of horses may survive the acute phase of HeV infection. Serological testing of blood samples taken at least 14 days post-infection may provide evidence of exposure to HeV.

Biosecurity Queensland will manage any case that is confirmed HeV positive by laboratory testing.

5. Develop a proforma HeV case investigation procedure

The following HeV case investigation procedure has been modelled on the steps recommended in section 4 and an internal Biosecurity Queensland work instruction for staff. It is provided with the intent to guide veterinarians in the development of their own HeV case investigation procedure.

Individual veterinarians will need to complete some details to suit their specific practice needs. Add information to the basic procedure below to personalise it for use in situations likely to be faced.

Alternatively, a veterinary practice could develop its own procedure to suit its specific situation.

Biosecurity Queensland recommends that on completion of an HeV case investigation procedure specific to a veterinary practice, a printed copy be kept and readily accessible in each practice vehicle. This should act as a checklist to ensure veterinarians adhere to all key elements in the investigation of potential HeV cases.

Laminating the investigation procedure will allow it to be carried onto the property and decontaminated before exiting the property.

5.1. HeV case investigation procedure

5.1.1. Warnings

Safety of people is the primary consideration. If any person is concerned about their health, they should seek medical advice and contact their local GP, their nearest Queensland Health Population Health Unit or the Queensland Health 24-hour hotline on **13 HEALTH (13 43 25 84)**.

Do not undertake a full necropsy on an exclusion or suspect case until laboratory testing and professional assessment has ruled out HeV.

Apply the precautionary principle. An infected horse can excrete HeV in nasal or nasopharyngeal secretions from two days following exposure to the virus, up to and including the time of clinical signs. A strongly symptomatic horse poses the greatest transmission risk to other horses and humans through a variety of body fluids and excretions.

- Ensure appropriate PPE is available and worn by the investigating veterinarian and all assistants. Limit contact with all other horses to essential people equipped with adequate PPE.
- Protect all exposed skin, mucous membranes and eyes from direct contact and prevent inhalation of airborne particulates.
- Ensure you have skilled assistance to handle horses being sampled.
- Only undertake absolutely necessary sampling to obtain a diagnosis of HeV.
- If the situation is unsafe, do not proceed; seek help to make the situation safe before sampling the horse/s.
- Use drugs to sedate horses if necessary.
- Isolate sick or dead horse/s from people and all other animals, including pets.
- Promote personal hygiene—especially hand washing and showering—for in-contact people.

5.1.2. Case definition

There are no pathognomonic signs that define HeV infection in horses. Horses that are infected with HeV have shown variable and often vague clinical signs.

HeV should be considered where there is acute onset of clinical signs such as increased body temperature, increased heart rate, and rapid progression to death associated with either respiratory and/or neurological signs.

Usually there is strong presentation of clinical signs; however, occasional cases will present with much milder clinical signs.

Table 2. Clinical signs observed in HeV cases

Common signs	Respiratory signs	Neurological signs
• acute onset of illness • increased body temperature • increased heart rate • discomfort/ weight shifting between legs • depression • rapid deterioration	• pulmonary oedema and congestion • respiratory distress—increased respiratory rates • terminal nasal discharge—can be initially clear progressing to stable white froth and/or stable blood-stained froth • terminal weakness, ataxia and collapse	• 'wobbly gait' progressing to ataxia • altered consciousness—apparent loss of vision in one or both eyes, aimless walking in a dazed state • head tilting, circling • muscle twitching—myoclonic spasms in acutely ill and recovered horses • urinary incontinence • recumbency with inability to rise
Other observations		
• previous unexplained horse deaths • facial oedema • facial paralysis and/or a locked jaw • spasms of the jaw, involuntary chomping • muscle trembling • altered gait, high stepping • congestion of oral mucous membranes	• anorexia • a high case fatality rate within 48 hours where there are multiple cases • colic-like symptoms in some cases (generally quiet abdominal sounds on auscultation of the abdomen in pre-terminal cases) • straining with difficulty passing manure	• stranguria (difficult urination); dribbling urine • hot hooves • bad breath/halitosis • delayed blood clotting times Proximity to flying foxes would support the above signs (though lack of sightings does not preclude HeV).

Table 3. Differential diagnoses for consideration

Other causes of acute death in horses	Other causes of respiratory or neurological disease in horses
• plant poisonings such as Crofton weed poisoning or avocado poisoning—some apparent HeV cases have, in fact, been avocado poisoning and vice versa • chemical poisonings—paraquat, lead, fluoroacetate, ionophores (e.g. monensin) • colic • intoxications (botulism) • acute bacterial diseases, such as anthrax • colitis • intestinal accidents • internal haemorrhage • snakebite • cardiac arrest • embolism • central nervous system trauma • aneurysm (aortic, pulmonary) • severe endotoxaemia • severe hyperthermia • severe hypothermia • endotoxic or hypovolaemic shock	• inhalation pneumonia or purulent bronchopneumonia • equine herpes virus (neurological strain) • Murray Valley encephalitis • exotic viruses such as African horse sickness, equine influenza, Japanese encephalitis, West Nile virus, encephalitides (eastern, western, Venezuelan), hantavirus pulmonary syndrome • acute septicaemias • purpura haemorrhagica • snake bite envenomation • paralysis tick (*Ixodes holocyclus*) • Kunjin virus • liver disease • interstitial pneumonia • Rhodococcus equi • shipping fever • neoplasia • central nervous system trauma • strangles

Exclusion case:

- an unexplained elevated temperature and heart rate
- any other of the signs listed
- HeV is one of a number of differential diagnoses being considered.

Suspect case:

- an unexplained elevated temperature and heart rate
- any other of the signs listed
- has exposure history, property history or other epidemiological evidence indicative of increased likelihood of being an HeV case
- HeV is a primary diagnosis.

Assess animals in close contact with the affected horse, including other horses, pets and any other animals. If these animals are also showing illness, they should be isolated and reported when notifying the case.

5.1.3. Make the necessary notifications

Biosecurity Queensland: **13 25 23** (business hours) or **1800 675 888** (out of hours). Contact the laboratory if you intend to send samples for HeV testing (see section 4.11 for contact details).

Arrange for sick or dead horses to be isolated from people and other horses and animals, ensuring they are away from boundary fences of the property. Identify and work with other people with site obligations (owner, manager, carer etc.) to make the site safe. Ensure you are aware of your workplace health and safety duties in the management of the veterinary workplace.

5.1.4. Determine the equipment required

1. Sampling requirements

- Determine how many animals are to be sampled and what samples will be safe to collect.
- Determine individual identification of all animals to be sampled.
- Try to collect more than one sample from each animal. This increases testing sensitivity.
- Label all sample containers uniquely before entry to property.
- Preferred samples from **live horses** are:
  - blood—whole blood, EDTA and lithium heparin
  - nasal swabs, oral swabs (tongue surface) and rectal mucosal swabs (not faecal swab)
  - urine swab (from the ground immediately post-urination if possible).
- Sampling equipment required to collect samples from each live horse:
  - shielded vacutainer needle and holder (plus several spares)
  - 1 x serum vacutainer, 1 x EDTA and 1 x lithium heparin vacutainer (plus spares)
  - 3 x virus transport media (plus spares)—if VTM is not available, place swabs in saline
  - 4 x swabs (plus spares)
  - sharps disposal container.
- Preferred samples from **dead horses** are:
  - nasal, oral, rectal mucosal swabs
  - blood—(if available) 1 x 10 mL serum tube, 1 x 10 mL EDTA tube and 1 x 10 mL lithium heparin tube

  Note: AAHL have indicated that the clot from the jugular vein (taken following cut-down onto the vein) and submandibular lymph node tissue can increase overall test sensitivity when combined with swabs. Collection of these samples requires limited necropsy work and should only be taken if the associated risks can be managed—including any blood released during the procedure.
- Sampling equipment required to collect samples from each dead horse:
  - shielded vacutainer needle and holder (plus several spares)
  - 1 x 10 mL serum tube, 1 x 10 mL EDTA tube and 1 x 10 mL lithium heparin tube (plus spares)
  - 3 x virus transport media (plus spares)–if VTM is not available, place swabs in saline
  - 4 x swabs (plus spares)
  - scalpel, scissors, forceps to collect tissue samples
  - sample jars for fresh and formalised tissue samples

  - cut-resistant gloves (e.g. Kevlar®) may be considered.
- Additional equipment:
  - small (but adequate) sharps container with built-in needle removal facility
  - 2 x A4 clip seal bags to remove samples off premises
  - plastic bucket for carrying equipment
  - a spray pack (500 mL) of Virkon® or other suitable disinfectant (soap, hypochlorite, iodophor/iodine, biguanidine, quaternary ammonium compound).

2. Personal protective equipment (PPE) per person

- 1 x pair of disposable overalls (at least splash resistant rating).
- 1 x disposable P2 (or N95) particulate respirator (plus spares), or reusable negative pressure respirator/s or PAPR/s and filters
- pack of disposable gloves (nitrile gloves recommended)
- safety eyewear and/or a face shield
- 1 x roll of duct tape
- 1 x pair of impervious rubber boots
- 1 x disposable or washable hat or cap if overalls do not have a hood
- cut-resistant gloves (e.g. Kevlar®) may be considered.

3. Disinfection and waste disposal equipment required (suggested minimum)

- foot bath and 2–3 buckets
- scrubbing brush
- hoof pick or medium screwdriver
- 20 L water
- Virkon® sachets or bulk supply (for mixing at 50 g per 5 L water) or supplies of other chosen disinfectant (hypochlorite, iodophor/iodine, biguanidine, quaternary ammonium compound)
- soap or detergent for personal decontamination
- small hand-sprayer for chosen disinfectant
- (if using reusable respirators) a small hand-sprayer with suitable disinfectant (e.g. Trigene®)
- 1 x heavy duty garbage bag
- 1 x clinical waste bag
- 2 x zip/cable ties
- ground sheet or plastic mat (no more than 1 m^2).

Note: Carefully consider any equipment you take onto a property. What cannot be successfully decontaminated off site must be left behind and dealt with later.

4. Communications

- Determine the communication system that will be used on site (e.g. mobile phone in zip lock/clip seal bag, landline).
- Ensure any communication item taken is able to be decontaminated off the property. For example, seal items in plastic bags or similar so they can be used without having to take them out of the bag, then decontaminate the outside of the bag.

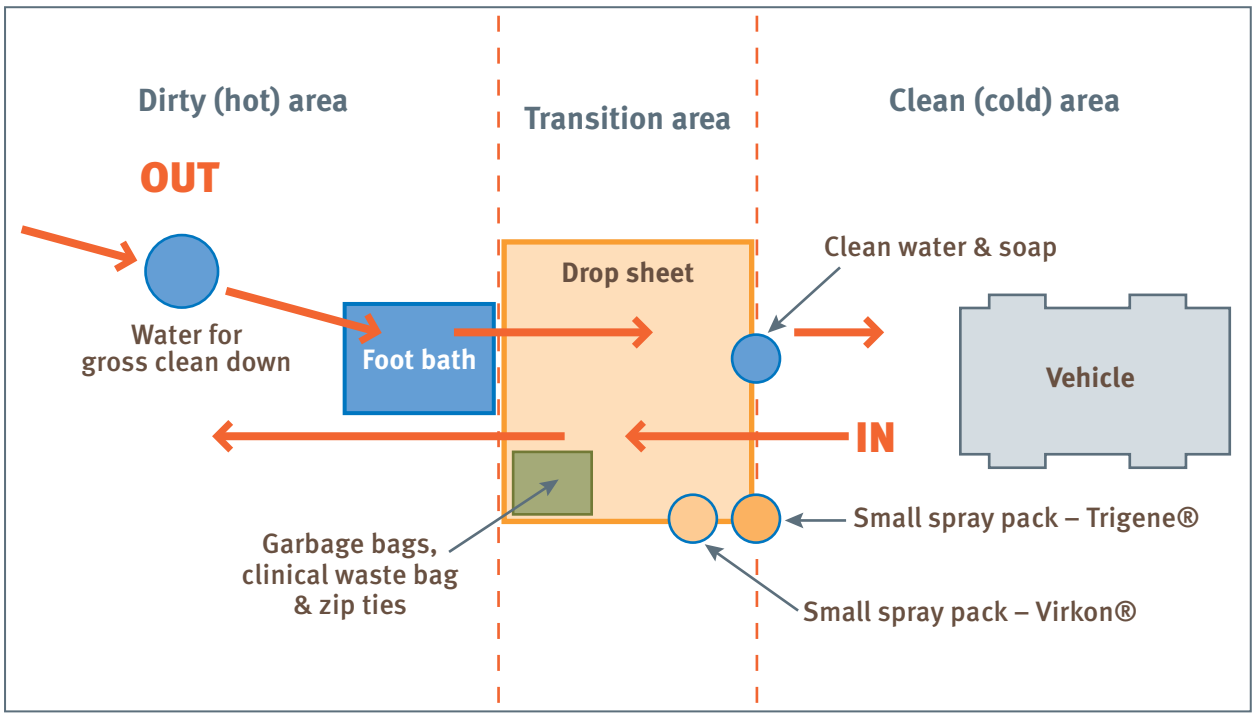
5.1.5. Before entering the property

Set up an entry/exit site (as per Figure 1 below).

At the selected entry/exit point, identify a 'clean' (cold) area, a 'dirty' (hot) area (i.e. the contaminated area where the possible case is situated) and a small transition area between the clean/cold and dirty/hot areas.

On the clean side, lay out all equipment required for the investigation and, before donning (putting on) PPE, double check that nothing has been missed and that no unnecessary equipment is being taken into the dirty area. Leave vehicles in the clean zone. If vehicles are taken into the dirty zone, they will need to be decontaminated.

Figure 1. Suitable entry/exit decontamination site



Then:

- Make sure containers of disinfectant, along with soap and clean water, are available and placed at the entry/exit point for use during exit.
- Don PPE in the following sequence to assist best personal protection:
  - Wash hands with soap/detergent.
  - Don overalls then boots (overall legs go outside boots).
  - Don safety eyewear, gloves and disposable or negative pressure respirator.
  - Fit check the respirator.
  - Pull overalls hood up if present and zip to chin.
  - Perform respirator fit check.
  - Double-glove and secure the outer gloves onto the sleeves of the overalls with tape.

If using a PAPR:

- Wash hands with soap/detergent.
- Don overalls then boots (overall legs go outside boots).

- Pull overalls hood up if present and zip to chin.
- Don PAPR then gloves.
- Double-glove and secure the outer gloves onto the sleeves of the overalls with tape.

Enter the 'dirty' area.

You should enter the dirty area only after fully dressed in PPE and with all required equipment.

Any person assisting or in close proximity must wear the same standard of PPE.

Undertake the required sampling.

- Make sure that specimens are uniquely AND clearly labelled.
- Do not place yourself or assistants at risk of injury at any time.
- Use techniques that minimise the chance of contamination of people and their PPE.
- Undertake safe sharps handling and disposal of waste to prevent accidental exposure via needlestick injury (i.e. do not re-cap needles, use the sharps container).

When sampling is completed:

- Place samples in a clip seal bag for removal.
- Leave the property, following the procedure below.

5.1.6. To leave the property

- Remove gross contamination from self and equipment.
- Do this before reaching the entry/exit point to minimise the risk of spreading contamination beyond the designated dirty area.
- Use a brush and soap or detergent and water.
- Clean the treads of the boots (e.g. at a tap on site or a bucket strategically placed back from the entry/exit site).
- Go to the dirty side of the entry/exit point.
- Double-bag the samples in clip seal bags and disinfect them to the clean side. Be careful not to contaminate the samples with disinfectant.
- Spray disinfectant on the outer gloves.

The final step is to remove PPE.

If non-disposable PPE cannot be adequately decontaminated on site, double-bag it and remove it for later attention—but this is not a preferred option.

Handle used PPE with care to avoid dispersal of contaminents.

To remove PPE where the respirator is a disposable P2 respirator or a reusable half-face or full-face respirator:

- Remove the outer pair of gloves to garbage bag.
- Wash hands, still encased in the inner pair of gloves, in disinfectant.
- Remove overalls to garbage bag.
- Remove boots and stand on hard standing or drop sheet/mat (transition area).
- Keep respirator on until overalls removed.
- Remove hat/cap to garbage bag or soak in disinfectant, seal in a bag and remove for laundering.
- Remove and disinfect safety eyewear, carefully avoiding splashes.
- Remove respirator (disposable respirators to garbage bag or mist/wipe reusable respirators with disinfectant solution). Do not touch the front of the respirator; handle by the straps.
- Remove inner gloves to garbage bag.
- Wash hands in clean water with disinfectant or use an alcohol-based hand rub.

Where the respirator is a powered air purifying respirator (PAPR):

- Remove the outer pair of gloves to garbage bag.
- Wash hands, still encased in the inner pair of gloves, in disinfectant.
- Remove and disinfect the PAPR.
- Remove overalls to garbage bag.
- Remove boots and stand on hard standing or drop sheet/mat (transition area).
- Remove the inner gloves to garbage bag.
- Wash hands in clean water with disinfectant or use an alcohol-based hand rub.

After removal of PPE:

- Place all waste material in garbage bag, seal with zip tie/cable tie and disinfect surface with Virkon®.
- Double-bag waste by placing garbage bag into a clinical waste bag, seal with zip tie/cable tie and disinfect surface.
- Disinfect and double-bag non-disposable items for removal.
- Put on street shoes again.
- Pack up disinfection site, disinfecting all equipment thoroughly as packed.
- Wash disinfectant off reusable respirators with clean water.
- Wash hands and other exposed skin with soap and water.
- Depart the area, taking care not to re-enter the dirty area.

5.1.7. Sample submission

- Complete a specimen advice sheet (SAS), available from **www.biosecurity.qld.gov.au** (search for 'GEN-008 Specimen advice sheet').
- Label as **HENDRA VIRUS EXCLUSION.**
- Pack securely according to the required standards and send to the **Biosecurity Sciences Laboratory (BSL)** or your closest Biosecurity Queensland laboratory where samples will be transferred to BSL for testing. Direct submission to BSL will achieve the shortest turnaround times. Contact details are provided in section 4.11.

OR

- Arrange with a courier company to pack (if you are unable to comply with the required standards) and dispatch the samples.

Advise the laboratory of sample dispatch and transport details—carrier, consignment note number and contact details. See section 4.11 for contact details.

5.1.8. Biosecurity advice to the owner

Provide advice appropriate to the situation to reduce the risk of further disease spread to people, horses and other animals.

Useful reference sources available at www.biosecurity.qld.gov.au are the fact sheets *Hendra virus: important information for horse owners* and *Information for horse owners* (in the Hendra virus—veterinary practice pack).

5.1.9. Disposal of the carcass

For burial on site or burning on site or transport off site:

- Contain body fluids and excreta if the carcass is moved.
- Dispose of contaminated soil and items with the carcass.
- Decontaminate equipment and items in contact with body fluids or excreta.
- Use PPE if there is a risk of contact with body fluids or excreta.

5.1.10. Subsequent actions

- Deal with any PPE not disinfected on site (dispose of or disinfect safely).
- Arrange for an appropriate contractor to dispose of clinical waste.
- As soon as possible after completion of duties, shower with soap, shampoo and water.
- Take downtime and manage activities required to complete downtime.

Note: If accidental exposure to blood or body fluid or sharps injury occurs, wash the affected area of skin thoroughly with soap and water and/or irrigate mucous membranes with water or saline. Seek immediate medical advice.

Appendix 1. HeV incident summary table

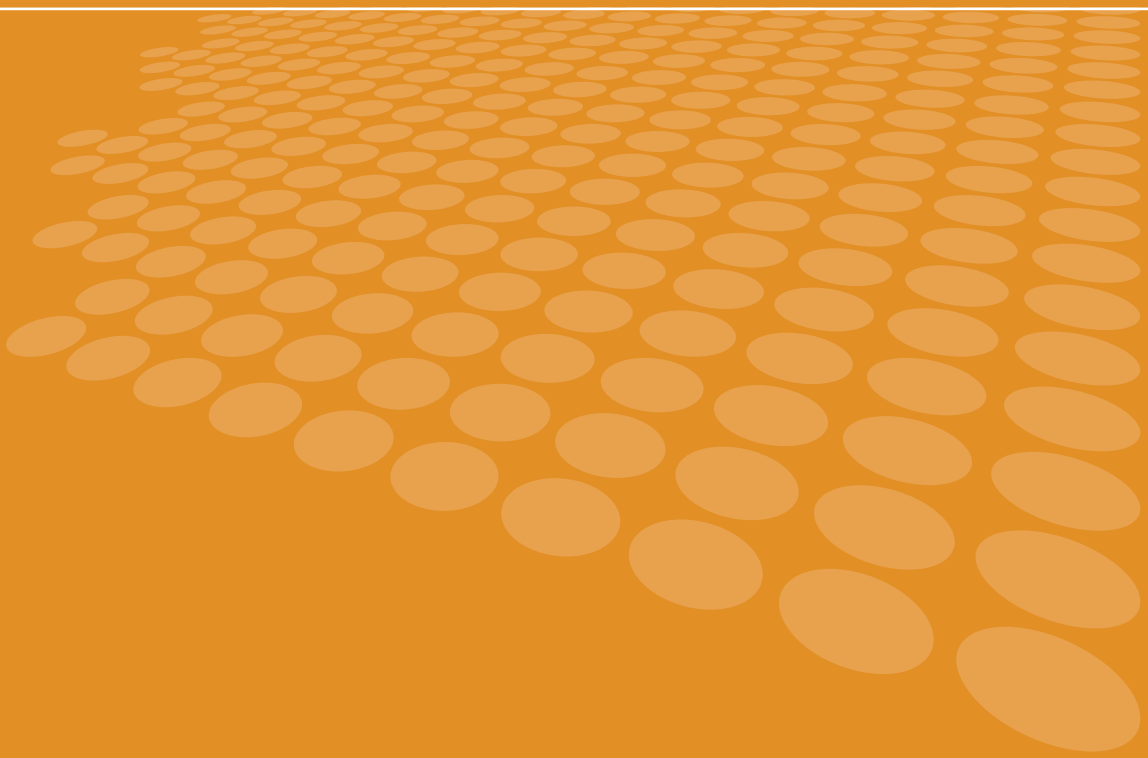
Incident	Location	Date	Positive human cases	Horses with positive laboratory test #	Horses with untested or unresolved status*	Other evidence
1	Mackay	August 1994	1 (1 death)	2		These cases did not become apparent until late 1995 when HeV infection was confirmed in a person from Mackay. Testing of stored samples from horses did not occur until late 1995, after confirmation of HeV involvement in the associated human case.
2	Hendra (Brisbane)	September 1994	2 (1 death)	7	13	HeV was first identified and characterised as a result of this event. No diagnostic tests were available until after the event and not all horses were tested as samples were not retained from all horses. Strong epidemiological evidence exists for all horses involved to be considered as cases based on concurrence of disease and other data. The seven horses with positive laboratory tests were non-fatally infected and antibody-positive.
3	Cairns (Trinity Beach)	January 1999		1		
4	Cairns (Gordonvale)	October 2004	1		1	Strong epidemiological evidence exists for this horse. A veterinarian was confirmed positive for HeV after performing a necropsy on a horse that died suddenly with signs consistent with HeV. No samples from the horse were available for testing. The horse was the only identified potential source. A description of the clinical and necropsy signs is strongly suggestive of HeV.
5	Townsville	December 2004		1		
6	Peachester	June 2006		1		
7	Murwillumbah	October 2006		1		
8	Peachester	June 2007		1		
9	Cairns (Clifton Beach)	July 2007		1		

Appendix 1. HeV incident summary table continued

Incident	Location	Date	Positive human cases	Horses with positive laboratory test #	Horses with untested or unresolved status*	Other evidence
10	Redlands	June 2008	2 (1 death)	5	3	Three horses have unresolved HeV status from this incident—all died at Redlands Veterinary Clinic in the month prior to the first confirmed case with clinical signs consistent with possible HeV cases. Necropsies were not completed on the horses and only limited laboratory samples were available to allow further testing. The samples were negative for HeV on the tests able to be undertaken. One of the five horses with a positive laboratory test was non-fatally infected and antibody-positive.
11	Proserpine	July 2008		3	1	One horse has an unresolved HeV status from this incident—a companion horse was found dead several days prior to the first confirmed case. Limited clinical history consistent with HeV infection was available. A necropsy was not performed. One of the three horses with a positive laboratory test was non-fatally infected and antibody-positive.
12	Cawarral	August 2009	1 (1 death)	3	1	Strong epidemiological evidence exists for a horse which died 12 days prior to the first confirmed case. (A veterinarian was confirmed positive for Hendra virus after performing a respiratory endoscopy on the horse.) A second horse was confirmed as HeV positive on stored blood samples. One of the three horses with a positive laboratory test was non-fatally infected and antibody-positive.
13	Bowen	September 2009		2		A companion horse euthanased a month prior to the original confirmed case horse was also confirmed positive through laboratory testing on a single formalised sample that was still available from that investigation.
14	Tewantin	May 2010		1		
15	Beaudesert	June 2011		1		
16	Boonah	June 2011		3		Test results confirmed the presence of antibodies to HeV in a dog on this property. It was reported that the dog did not show any clinical signs of illness. No HeV genetic material was detected by PCR in samples collected from the dog on three occasions over a three week period. This was the first reported case of HeV antibody detection in a dog outside of an experimental setting.

Incident	Location	Date	Positive human cases	Horses with positive laboratory test #	Horses with untested or unresolved status*	Other evidence
17	Logan Reserve	June 2011		1		This horse was euthanased by a private veterinarian on 28 June 2011. Initial test results from samples collected on 26 June 2011 returned negative PCR results. These blood samples along with samples collected on 28 June 2011 were sent to AAHL for further testing. This testing found the horse had antibodies to HeV and identified extremely low levels of HeV via PCR in blood collected on 26 June 2011.
18	Wollongbar	June 2011		2		
19	Park Ridge	July 2011		1		
20	Macksville	July 2011		1		
21	Kuranda	July 2011		1		
22	Lismore	July 2011		1		
23	Hervey Bay	July 2011		1		
24	Boondall	July 2011		1		
25	Chinchilla	July 2011		1		
26	Mullumbimby	July 2011		1		
27	Ballina	August 2011		1		
28	South Ballina	August 2011		2		
29	Mullumbimby	August 2011		1		
30	Gold Coast hinterland	August 2011		1		
31	North Ballina	August 2011		1		
32	Beachmere	October 2011		2	1	One horse on this property was euthanased by a private veterinarian approximately one week before the first confirmed HeV case. This horse became acutely ill showing clinical signs similar to the first confirmed case on this property. There were no samples available from this horse to be tested. The second horse with a positive laboratory test was non-fatally infected and antibody-positive.
Total			**7 (4 deaths)**	**52 (all deceased)**	**20 (all deceased)**	

A case is taken as a horse that has tested positive for HeV, including serological, molecular or other diagnostic testing techniques, or where there is a very high level of likelihood of being infected with HeV as demonstrated by other test results. * As further information becomes available, the status of these horses may change.



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