

AUSTRALIAN VETERINARY EMERGENCY PLAN

# AUSVETPLAN

Response strategy

African horse sickness

Version 5.0

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

**National Biosecurity Committee**

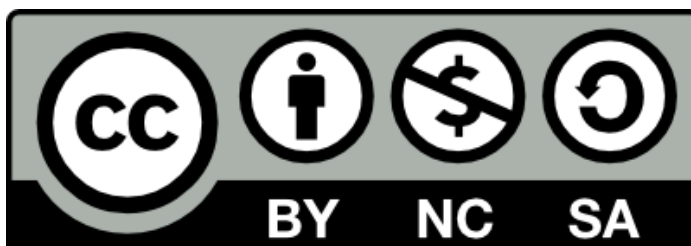
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# 1 Introduction

## 1.1 This manual

### 1.1.1 Purpose

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

### 1.1.2 Scope

This response strategy covers AHS caused by AHS virus.

This response strategy provides information about:

- the disease (Section 2)
- the implications for Australia, including potential pathways of introduction; social, environmental, human health and economic effects; and the critical factors for a response to the disease (Section 3)
- the agreed policy and guidelines for agencies and organisations involved in a response to an outbreak (Section 4)
- declared areas and premises classifications (Section 5)
- biosecurity controls, including quarantine and movement controls (Section 6)
- response surveillance and establishing proof of freedom (Section 7).

The key features of AHS are described in the **African horse sickness fact sheet** (Appendix 1).

### 1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak of AHS are based on risk assessment. They are informed by the recommendations in the World Organisation for Animal Health (WOAH, formerly OIE) *Terrestrial animal health code* (Chapter 12.1) and the WOAH *Manual of diagnostic tests and vaccines for terrestrial animals* (Chapter 3.6.1). The strategies and policy guidelines are for emergency situations and are not applicable to policies for imported animals or animal products.

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

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

## 1.2 Other documentation

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

- other AUSVETPLAN documents, including the operational, enterprise and management manuals; and any relevant guidance and resource documents. The complete series of manuals is available on the Animal Health Australia website<sup>1</sup>
- relevant nationally agreed standard operating procedures (NASOPs).<sup>2</sup> These procedures complement AUSVETPLAN and describe in detail specific actions undertaken during a response to an incident. NASOPs have been developed for use by jurisdictions during responses to emergency animal disease (EAD) incidents and emergencies
- relevant jurisdictional or industry policies, response plans, standard operating procedures and work instructions
- relevant Commonwealth and jurisdictional legislation and legal agreements (such as the Emergency Animal Disease Response Agreement<sup>3</sup>), where applicable.

## 1.3 Training resources

### **EAD preparedness and response arrangements in Australia**

The EAD Foundation online course<sup>4</sup> provides livestock producers, veterinarians, veterinary students, government personnel and emergency workers with foundation knowledge for further training in EAD preparedness and response in Australia.

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<sup>1</sup> <https://animalhealthaustralia.com.au/ausvetplan>

<sup>2</sup> <https://animalhealthaustralia.com.au/nationally-agreed-standard-operating-procedures>

<sup>3</sup> <https://animalhealthaustralia.com.au/eadra>

<sup>4</sup> <https://animalhealthaustralia.com.au/online-training-courses>

## 2 Nature of the disease

African horse sickness (AHS) is a serious arboviral disease affecting all species of Equidae (horses, mules, donkeys and zebras) and, occasionally, canids.

### 2.1 Aetiology

AHS is caused by a double-stranded RNA virus in the *Orbivirus* genus of the family *Reoviridae*, which also contains bluetongue and epizootic haemorrhagic disease viruses. Nine serotypes of AHS virus are known (AHSV-1–AHSV-9) (McIntosh 1958, Dennis et al 2019).

Cross-protection exists between serotypes 1 and 2, serotypes 3 and 7, serotypes 5 and 8, and serotypes 6 and 9 (OIE 2020a). No cross-reactions with other known orbiviruses have been observed. Although serotyping is important for vaccine implementation, it does not appear to determine the form of the disease expressed or disease susceptibility.

### 2.2 Susceptible species

All members of the horse family (Equidae: horses, mules, donkeys and zebras) are susceptible, with horses generally experiencing the most severe disease and highest case fatality rates (70–95%).<sup>5</sup> Donkeys are moderately susceptible and have a case fatality rate of 10% (OIE 2019). Species of zebra and the African donkey become infected, but generally have mild or subclinical disease that is referred to as horse sickness fever (Coetzer & Guthrie 2004).

Dogs (and potentially dingoes) can develop a transient low-level viraemia after insect inoculation, which is rarely fatal; surviving dogs may develop antibodies to AHS virus (van Sittert et al 2013, O’Dell et al 2018). Dogs can also contract a fatal form of AHS after eating infected meat (Coetzer & Guthrie 2004).

Elephants, camels, black and white rhinoceroses, sheep and goats have all been found with positive antibody titres to AHS virus, but with no evidence of clinical disease or involvement in the spread of the disease (Binopal et al 1992, Barnard et al 1995, Fischer-Tenhagen et al 2000).

Experimental inoculation has caused seroconversion in jackals and hyenas, with no evidence of clinical disease. Naturally occurring antibodies to AHS virus have been detected in a variety of African carnivores (Alexander et al 1995).

#### 2.2.1 Zoonotic potential

The disease does not affect humans.

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<sup>5</sup> The term ‘case fatality rate’ refers to the proportion of infected animals that die of the disease among all animals diagnosed with the disease at the time. Not all horses exposed to vectors at a location will develop infection.

## 2.3 World distribution

For the latest information on the distribution of AHS, refer to the World Organisation for Animal Health (WOAH) World Animal Health Information System.<sup>6</sup>

### 2.3.1 Distribution outside Australia

The distribution of AHS is primarily dictated by the presence of the principal insect vectors: *Culicoides* midge species. The main field vectors in endemic areas are *Culicoides imicola* and *C. bolitinos*, although other potential *Culicoides* vectors have been identified (Spickler 2015, Robin et al 2016).

AHS is endemic in all parts of sub-Saharan Africa, with periodic spread further north. It has occurred in Egypt and the Middle East, extending to Pakistan and India in the early 1960s. Spread from north Africa to the Iberian Peninsula has been documented, as has spread from Spain to north Africa (Coetzer & Guthrie 2004).

All serotypes occur in eastern and southern Africa. Only serotypes 9, 4 and 2 occur in north and west Africa, and occasionally spread from there into countries surrounding the Mediterranean.

An outbreak of AHS (serotype 1) was reported in Thailand in 2020 (OIE 2020b), affecting numerous provinces and leading to the death of more than 500 horses. The outbreak was managed by protection of horses from vectors, and vaccination using a multivalent attenuated ('live') vaccine from South Africa. In August 2020, AHS was subsequently reported in five horses in the Malaysian province of Terengganu. All five horses were destroyed.

### 2.3.2 Occurrence in Australia

Australia is recognised by WOAH as a country free from AHS.

AHS has not occurred in Australia.

## 2.4 Epidemiology

### 2.4.1 Incubation period

The incubation period in horses (the intrinsic incubation period) may be as short as 3 days or as long as 14 days (Spickler 2015), but is usually 5–9 days. Experimentally, incubation periods of up to 21 days have been suggested (Spickler 2015).

#### WOAH infective period

The WOAH *Terrestrial animal health code* defines an infective period for AHS rather than an incubation period. The infective period is the longest period during which an affected animal can be a source of infection; for domestic horses, the infective period for AHS is 40 days (OIE 2021).

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<sup>6</sup> <https://wahis.woah.org/#/home>

## 2.4.2 Persistence of agent and modes of transmission

### General properties

Although AHS virus is very stable outside the host, this is of little epidemiological significance because AHS is a vector-borne disease. AHS virus (Spickler 2015, OIE 2020a):

- has an optimal pH for survival of 7.0–8.5
- is relatively heat stable; the infectivity of citrated plasma containing AHS virus is not reduced by heating at 55–75 °C for 10 minutes
- can be stored for at least 6 months at 4 °C in saline containing 10% serum
- can be recovered for 12 months from washed erythrocytes stored at 4 °C
- is not destroyed by putrefaction and may retain infectivity in putrid blood for more than 2 years, but is rapidly destroyed by rigor mortis; the virus is likely to be inactivated by carcass pH of 6.0 or below, associated with rigor mortis (MacDiarmid 1991, Scott Williams Consulting & Herd Health 2017)
- is sensitive to acid pH but is relatively resistant to alkaline pH conditions
- is resistant to lipid solvents, such as ether
- is inactivated by acetic acid (2%), formalin (0.1%) for 48 hours, potassium peroxymonosulfate/sodium chloride (1%), beta-propiolactone (0.4%), binary ethylenimine and sodium hypochlorite (3%).

### Environment (including windborne spread)

AHS virus is not spread by aerosol; however, windborne spread of insect vectors is a risk factor in the transmission of the disease (see Section 2.4.3). In countries where AHS is endemic, the disease often has an association with El Niño–Southern Oscillation events in which drought is followed by heavy rain (Baylis et al 1999, Coetzer & Guthrie 2004, OIE 2020a). Heavy rains can significantly increase the abundance of adult *Culicoides*, up to 200-fold (Wilson et al 2009).

### Live animals

#### *Live domestic animals*

AHS is transmitted between susceptible animals by blood-feeding insect vectors. It is not spread by direct contact between infected and noninfected animals. Horses and dogs are the main domestic species that are susceptible to the disease. Viraemia in horses can last up to 21 days experimentally, although the viraemic phase is usually 4–8 days (Spickler 2015). Viraemia in donkeys has been recorded to last as long as 28 days (Mellor & Hamblin 2004, Spickler 2015).

The duration of viraemia in dogs is not known but has been reported as ‘short’ (McIntosh 1955). It is unlikely, although uncertain, that dogs play a role in onward transmission of the virus (Oura 2018).

Recovered animals are not carriers of the disease (Robin et al 2016, OIE 2020a).

#### *Live wild (including feral) animals*

Equids are primary and amplifying hosts, and populations of feral equids (especially donkeys) may act as ongoing sources of infection for vectors. In Africa, zebras and African donkeys are the main wild animals involved in the spread of AHS. Zebra populations can act as reservoir hosts when their numbers and herd structures are large enough (OIE 2020a). Viraemia can persist in zebras for up to 40 days, and virus has been detected in zebra spleens for 48 days (Barnard et al 1994, Spickler 2015).

Donkeys 'almost certainly' act as reservoir hosts in northern parts of Africa (Robin et al 2016). The seroprevalence of AHS in north African donkeys and mules was up to 37.5% (Demissie 2013), and in donkeys in Kenya around 35% (Gichure et al 2020).

## **Carcasses**

AHS virus may remain active in horse carcasses, and dogs eating infected horsemeat may become infected. The reduced pH associated with rigor mortis will rapidly destroy the virus in meat and carcasses (OIE 2020a).

## **Animal products**

### **Meat, meat products and casings, including use as animal feed**

Dogs may contract a fatal form of AHS after eating infected horsemeat (Coetzer & Guthrie 2004, OIE 2020a).

AHS virus can survive in frozen but not salted meat. At pH values below 6.0, as found in meat that has undergone rigor mortis, the virus is inactivated quickly. It is also inactivated by heat treatment. MacDiarmid (1991) reported temperatures above 60 °C to be sufficient; OIE (2020a) stated that the virus can be inactivated by heating to 72 °C for 120 minutes.

## **Animal byproducts**

### **Hides, skin, wool and other fibres**

Insect transmission of AHS virus suggests that the risk of skin, hides or fibres becoming infective is negligible (Herd Health 2017).

### **Semen and embryos from live susceptible animals**

AHS virus is present in semen and embryos of infected equids, but there are no reports of transmission by either (OIE 2020a). The WOAHS Terrestrial Code recommends measures to demonstrate freedom from infection with AHS virus of imported equine semen, oocytes and embryos.

AHS has not been categorised by the International Embryo Technology Society (IETS). The IETS categorises bluetongue virus, a closely related orbivirus, as Category 1 (cattle) or Category 2 (sheep), indicating a negligible risk of transmission. For AHS virus, the risk is unknown.

A negative serological test, carried out 21 days after collection of semen from an unvaccinated equid, would indicate that the animal has not been exposed to AHS and that the semen will also be free of AHS virus (EFSA 2021).

## **Specimens**

AHS virus is present in blood and visceral samples; it can survive for up to 6 months at 4 °C in sources containing serum and for more than 2 years in putrid blood (Spickler 2015). However, there is no record of virus spread through blood or other samples.

## **Waste products and effluent**

Although AHS virus is present in urine and other body secretions of infected animals, no transmission of disease by contact with, inhalation of, or ingestion of, these materials is known (OIE 2020a).

## **Biological products (eg vaccines)**

Polyvalent attenuated ('live') vaccines to AHS have been shown to revert to virulence and/or reassort in vaccinated animals, from which they can be spread by competent vectors to nearby susceptible horses (Weyer et al 2016).

## **Nonsusceptible animals**

AHS virus requires a competent insect vector and cannot be spread by nonsusceptible animals.

## **People**

People are not susceptible to infection with AHS virus and do not represent a potential source of infection.

## **Crops, grains, hay, silage and mixed feeds**

Feedstuffs are not implicated in the spread of AHS.

## **Vehicles, including empty livestock transport vehicles**

AHS virus is not spread mechanically by vehicles, including empty transport vehicles; however, vehicles should be thoroughly cleaned and disinfected to reduce the possibility of transport of infected vectors to a new location.

## **Equipment, including personal items**

Because AHS is a noncontagious disease, fomites generally do not present a risk. Although not yet validated, mechanical transmission could occur via veterinary equipment, multiple-dose vials and hypodermic needles contaminated by AHS virus-infected blood. Other orbiviruses, such as bluetongue virus, are known to spread on contaminated sharps (Spickler 2015).

## **Arthropod vectors**

Insect vectors provide the natural means of transmission of AHS. Worldwide, 15 arthropod vector species have been identified, in either the field or the laboratory (EFSA AHAW Panel 2017). Biting midges from the genus *Culicoides* are the most important vectors. In South Africa and Spain, *C. imicola* and *C. bolitinos* midges are the main vectors for AHS virus. *C. bolitinos* midges breed in the dung of herbivores (Meiswinkel 1989) and so are not as reliant on rainfall events and soil type as *C. imicola*. *C. brevitarsis*, a close relative of *C. imicola*, is widespread in Australia, often causing an allergic dermatitis of horses known as Queensland itch (Riek 1953, Reye 1964). *C. oxystoma*, present in northern Australia, is also a potential vector of AHS virus, known to feed on horses (Fall et al 2015). The competence of Australian species of *Culicoides* for AHS virus is unknown, but it must be assumed

that *C. brevitarsis* is competent and that there is potential for other *Culicoides* species to transmit AHS virus. The main North American bluetongue vector *C. sonorensis* (formerly *C. variipennis*) has also been shown experimentally to be a competent vector for AHS virus.

AHS virus has been experimentally transmitted to horses by three species of mosquito: *Aedes aegypti*, *Culex pipiens* and *Anopheles stephensi* (Ozawa & Nakata 1965, Ozawa et al 1966, both cited in Carpenter et al 2017). The first two of these species occur in Australia. Experimentally infected mosquitoes transmitted AHS virus to horses 15–22 days post-infection. In some mosquitoes, virus was still present 35 days after infection (Ozawa & Nakata 1965, Ozawa et al 1966, both cited in Carpenter et al 2017). The significance of mosquito species as potential vectors of AHS virus remains uncertain (Carpenter et al 2017).

AHS virus has also been isolated from the brown dog tick (*Rhipicephalus sanguineus*) after it fed on experimentally infected dogs, and from camel tick (*Hyalomma dromedarii*) collected in the field. Both species have transmitted the virus experimentally, the former (which is present in Australia) to dogs and horses, and the latter (which is not present in Australia) to camels (Carpenter et al 2017).

Vectors that become infected with an arbovirus are thought to remain infected for life; the life of an adult *Culicoides* midge is generally 10–30 (but up to 90) days (Mellor et al 2000). The competence of insect vectors is diminished by low temperatures (the virus does not replicate below 15 °C) and is generally increased by high temperatures. The virus can persist in relatively long-lived midge vectors without replicating, and resume replication as temperatures increase (Wilson et al 2009, Spickler 2015). Adult midges can also survive for relatively long periods in cold weather, suggesting that AHS virus could survive short, mild winters in small numbers of midges (Wilson et al 2009).

Newly emerged female adult midges take a blood meal within 1 day of emerging from the larval stage and then may take a blood meal every 3–4 days after oviposition. AHS virus multiplies and reaches a high titre in *C. imicola* midges on the fifth day after they ingest infected blood and localises in the salivary glands, from where it is transmitted to the next host. The interval between feeding and localisation in the salivary glands is known as the extrinsic incubation period. *C. imicola* midges have been able to transmit infection to other horses 7–13 days after feeding on an infected horse. The period between a midge biting an infected horse and the disease being seen later in another horse bitten by that midge could be as short as 12–16 days (mean 14 days), but is more likely up to 21 days, based on the typical extrinsic and intrinsic incubation periods in the midge and horse (Mellor & Boorman 1995).

There is no evidence of mechanical transmission by vectors. However, mechanical spread, particularly by stable flies (*Stomoxys calcitrans*), buffalo flies (*Haematobia irritans exigua*) and March flies (Tabanidae), should not be ruled out.

### 2.4.3 Factors influencing transmission

Because AHS virus is transmitted by infected biting insects (primarily adult females from several species of *Culicoides*), the weather is involved in cycles of disease transmission. Heavy rains preceded by drought favour expansion of *Culicoides* populations, which increases the likelihood of epizootics. In southern Africa, El Niño events are often associated with population expansions. Climate change has increased the distribution of bluetongue virus by extending the range of vectors and the potential for transmission, and may also have implications for transmission of other orbiviruses such as AHS virus (Wilson et al 2009).

The hours between dusk and dawn are the most significant for midge activity. *C. imicola* midges, the primary vector, are reluctant to enter housing; this is not the case with *C. bolitinos* midges.

The prevalence of infection with AHS virus in field-collected *Culicoides* during outbreaks can be as low as 0.003% (Venter et al 2006). However, in outbreak situations in South Africa, the abundance of midges compensates for the low infection rates.

Midges have a range of a few kilometres from their breeding site, but can be blown by wind for tens of kilometres over land and hundreds of kilometres over water (Elbers et al 2015). Bishop et al (2004) suggested that it may take 15–18 weeks for *Culicoides brevitarsis* to be dispersed 100 km in New South Wales under certain weather conditions. However, evidence has also been presented for long-distance (130–200 km) windborne dispersal of *Culicoides* vectors over land in New South Wales, in association with unique single weather events (Murray 1987).

In northern Australia, where there is greater availability and activity of suitable vectors, combined with favourable environmental conditions, disease is likely to be more widespread, and morbidity and mortality higher, than in other regions if a sufficiently large equid population is present.

Transportation of infected, incubating or asymptomatic equids, and movement of infected feral equids contribute to the broad distribution of the disease. Importation of zebras has been implicated in some outbreaks outside Africa (eg Iberian Peninsula, Thailand). Illegal movement of horses between zones of different AHS status was implicated in an outbreak of AHS in a surveillance zone in South Africa, resulting in loss of international trade in horses from the AHS-free zone (Grewar et al 2013).

Recovered horses are not carriers of the disease.

## 2.5 Diagnostic criteria

### 2.5.1 Clinical signs

AHS is frequently fatal in susceptible horses, producing clinical signs associated with endothelial cell dysfunction, leading to oedema, petechial haemorrhage and vascular congestion throughout the body. Clinical signs associated with impairment of respiratory and circulatory function are the most obvious disease manifestations, but all body systems are affected. AHS is likely to affect only a proportion of horses at a location, but the case fatality rate in infected horses may be high (70–95%). For mules and donkeys, the case fatality rate may be lower. Negligible mortalities occur with mild or subclinical disease in zebras and African wild donkeys in endemic areas.

There are four classical clinical disease syndromes of AHS:

- peracute (pulmonary) form
- subacute oedematous (cardiac) form
- acute (mixed) form
- mild (horse sickness fever) form.

However, there is enough overlap to make these rigid distinctions into distinct AHS syndromes difficult to justify. Most cases are, to a greater or lesser degree, mixed in type. A nervous form may occur rarely (OIE 2020a).

In the early stages of the AHS outbreak in Thailand in 2020, infected horses showed clinical signs including supraorbital oedema, frothy discharge from the mouth and nose, fever, and sudden death within 24 hours of showing signs (King et al 2020).

Infected dogs develop anorexia, lethargy, respiratory distress and excess salivation; death may occur within a day to a week following development of clinical signs (van Sittert et al 2013, O'Dell et al 2018).

### *Peracute (pulmonary) form*

- Short clinical course, characterised by high fever (40–41 °C), progressive severe respiratory distress with paroxysmal coughing and dyspnoea, bilateral foamy nasal discharge, sweating and high case fatality (up to 95%).
- Death usually occurs 4–5 days after the onset of depression.
- Recovery is rare.

This form of the disease occurs in highly susceptible horses and may be encountered in Australian horses unless the strain of AHS virus is of low virulence. However, a spectrum of clinical presentations could be expected in donkeys and feral equids. The fatal disease in dogs is usually of this form, with death occurring within 24 hours.

### *Subacute oedematous (cardiac) form*

- Incubation period varies from 7 to 21 days.
- Fever (39–41 °C), lasting for 3–4 days.
- As the fever subsides, oedema of the supraorbital fossae and eyelids develops, spreading to the head, neck, and sometimes shoulders and chest. Oedema of the lower legs is absent. Auscultation may reveal hydrothorax and hydropericardium.
- Haemorrhage is present as petechiae of the conjunctivae, and ecchymoses or petechiae of the ventral tongue.
- Colic may occur.
- Death, preceded by progressive dyspnoea, occurs within 4–8 days after onset of fever.

This form has a case fatality rate of 50–70%, and is caused by less virulent virus strains or where there is already some degree of immunity in the population. In animals that recover, oedema usually subsides in 3–8 days. Mules can develop this form of AHS.

### *Acute (mixed) form*

- A combination of the pulmonary and cardiac forms of the disease.
- Case fatality rate may exceed 70%, with death occurring in 3–6 days.
- Most common in endemic areas.

### *Mild (horse sickness fever) form*

- Common in zebras; African donkeys; and partially immune horses, domestic donkeys and mules.
- Mildest form of AHS, frequently subclinical and therefore easily overlooked.
- Transient fever up to 40 °C can occur for 2–3 days, and is typically more pronounced in the afternoon.
- Oedema of the supraorbital fossa is seen.
- Variable incubation period of 4–14 days.

## **2.5.2 Pathology**

The underlying pathology of AHS is vascular endothelial damage in target organs, followed by effusion (Robin et al 2016). This results in the transudation of plasma into the tissues and body cavities. Lesions can be explained by the pathogenesis of the disease, which resembles that associated with an immune-complex reaction.

## **Gross lesions**

In peracute (pulmonary) cases of AHS, there is a marked hydrothorax with several litres of exudate in the chest, severe alveolar and interstitial oedema, and froth-filled trachea. Peri-aortic and peri-tracheal oedematous infiltration and oedema of the mediastinal nodes are often present. Petechial haemorrhages are present in the pericardium, and there may be a slight increase in pericardial fluid.

In the cardiac (subacute) form, a yellow, gelatinous oedema of the subcutaneous and intermuscular connective tissue in the head and neck is a characteristic finding (Lubroth 1988). This is often most severe around the ligamentum nuchae, and may extend to the chest, the shoulders and along the back. Severe hydropericardium is consistently present. The myocardium may contain areas of pale, grey blanching. It is notable that the oedema in the cardiac form is typically dorsal and localised (Coetzer & Guthrie 2004).

In both the pulmonary and cardiac forms, ascites may be seen, together with areas of hyperaemia, and petechial haemorrhages of the serosal surfaces of the large and small intestines. Also often seen are hyperaemia of the glandular fundus of the stomach; enlarged, oedematous mesenteric lymph nodes; subcapsular petechiae of the kidney and spleen; and ecchymotic or petechial haemorrhages on the diaphragm. These abdominal lesions are generally more severe in the cardiac form.

Hydropericardium is a prominent feature of the cardiac form. The pericardium can contain excessive straw-coloured fluid, and there are petechial and ecchymotic haemorrhages on the epicardium and endocardium (Coetzer & Guthrie 2004, Spickler 2015).

## **Microscopic lesions**

There are no specific microscopic features for AHS. Pulmonary oedema; early cardiac necrosis; and congestion, haemorrhage and oedema in many body tissues are usually seen, but are not unique to this disease.

## **Pathogenesis**

The pathogenesis of AHS is not fully understood; however, the virus initially localises in regional lymph nodes near the site of the initial insect bite and undergoes replication, followed by a primary viraemia. This leads to infection of organs such as the lungs, large intestines and lymphoid tissues, followed by a secondary viraemia.

A review of field and experimental cases using immunohistochemistry by Clift & Penrith (2010) found that microvascular endothelial cells and monocytes–macrophages were the most commonly targeted cells for virus replication. Clift & Penrith (2010) also confirmed that the heart and lung were the main target tissues for the virus, followed by the spleen.

### **2.5.3 Differential diagnosis**

#### **Differential diagnosis**

AHS must be differentiated from other diseases causing sudden death, respiratory distress or oedema.

The diseases and conditions to be included in the differential diagnosis relevant to the primary clinical signs include:

*Sudden death*

- infection with Hendra virus
- adverse drug reaction
- acute fulminating colitis
- snake bite
- pneumothorax
- toxic plants and chemicals
- endotoxaemia
- monensin toxicity
- infection with *Bacillus anthracis* (anthrax)
- equine encephalosis (exotic)
- Australian bat lyssavirus.

*Peripheral oedema*

- lymphatic obstruction
- trauma
- cellulitis
- parasitism
- hypersensitivity with urticaria (eg drug reaction)
- vasculitis
- purpura haemorrhagica
- protein-losing enteropathy
- phenylbutazone (PBZ) toxicity
- renal failure
- heart failure
- equine viral arteritis
- equine infectious anaemia
- equine babesiosis (piroplasmiasis) (exotic).

*Respiratory distress*

- infection with Hendra virus
- anaphylaxis
- pneumonia/pleuropneumonia
- choking
- tumour of the respiratory tract
- Crofton weed poisoning.

## **2.5.4 Laboratory tests**

### **Samples required**

Specimens required for the confirmation of AHS include:

- for agent detection and characterisation – fresh samples

- from live animals, whole blood; specimens for AHS virus isolation are best taken from animals in the early febrile stages of the disease
- from dead animals (in addition to samples from live animals, if available), blood, tissue samples, including lung, spleen, lymph nodes and heart, and any other observed lesions
- for serology, serum; for horses in the convalescent stages, blood samples (serum) for antibody detection must be collected
- for histopathology (for differential diagnosis), samples of lesion tissue (as above) in formalin.

As Hendra virus infection and anthrax are possible differential diagnoses for AHS, the biosecurity and safety requirements for these diseases must be considered when sampling for AHS. State and territory protocols for handling potential Hendra or anthrax cases should be consulted before sampling; these protocols may preclude necropsy examination of dead animals. It is important to note that swabs alone are unlikely to offer sufficient sensitivity to exclude AHS with confidence, and, at a minimum, a blood sample (ie by jugular cut-down) should be obtained.

Note that two samples of each of the above should be taken, with the second sample held in the jurisdiction in case further investigation is required. For further information, see the **AUSVETPLAN management manual *Laboratory preparedness***.

### **Transport of specimens**

Specimens should be submitted in accordance with agreed state or territory protocols. Specimens should initially be forwarded to the state or territory laboratory for appropriate analysis, and assessment of whether further analysis will be required by the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP), Geelong.

If the state or territory laboratory deems it necessary, duplicate samples of the specimens should be forwarded to CSIRO-ACDP for emergency disease testing, after the necessary clearance has been obtained from the chief veterinary officer (CVO) of the state or territory of the suspect case, and after the CVOs of Victoria and Australia have been informed about the case and the transport of the specimens to Geelong (for the first case). Sample packaging and consignment for delivery to CSIRO-ACDP should be coordinated by the relevant state or territory laboratory.

For further information, see the **AUSVETPLAN management manual *Laboratory preparedness***.

### **Packing specimens for transport**

In general, suspected AHS specimens are classified as Category B under the International Air Transport Association regulations and should be packaged according to UN 3373 ('Biological substance, Category B'). If Hendra virus is considered a differential diagnosis, the specimens are likely to be classified as Category A and will need to be packaged according to UN 2814 ('Infectious substance, affecting humans').

Before shipping specimens, submitters should contact the receiving laboratory to discuss arrangements for sampling, transport and sample reception.

Blood and unpreserved tissue samples for virus isolation should be forwarded to the laboratory at around 4 °C on water ice or with frozen gel packs.

## 2.5.5 Laboratory diagnosis

Confirmation of a diagnosis of AHS and determination of the serotype involved can be undertaken at CSIRO-ACDP.

The laboratory tests currently available at CSIRO-ACDP are shown in Figure 2.1 and Table 2.1.

CSIRO-ACDP can perform real-time polymerase chain reaction (PCR) as a rapid and reliable diagnostic test. Real-time PCR takes 4–5 hours to deliver a result.

Virus isolation in cell culture is useful for specimens with small amounts of virus, to amplify the virus for subsequent characterisation and serotype differentiation by whole-genome sequencing. The isolation procedure takes a few days, or longer if passaging is required. Subsequent characterisation by whole-genome sequencing may take an additional 5 days. In samples with larger amounts of virus, characterisation may be possible without the need to amplify the virus in cell culture.

Antibodies to the virus appear in the serum 7–10 days after infection. Enzyme-linked immunosorbent assay (ELISA)-based tests can be used to detect these antibodies, across the range of serotypes. Serum neutralisation tests are used for serotyping.

Whole-genome sequencing can be used for molecular epidemiology.

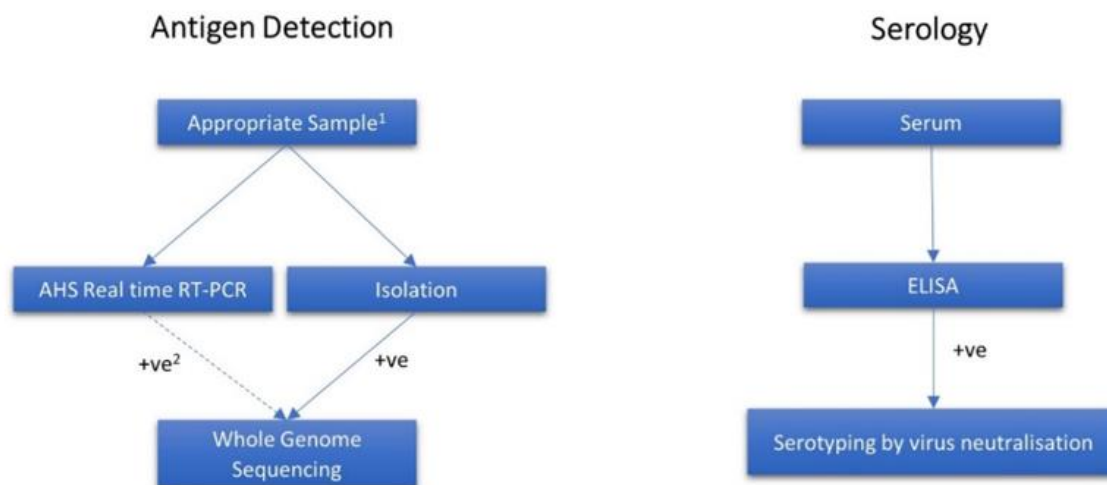
**Table 2.1 CSIRO-ACDP tests for diagnosis of African horse sickness**

Test	Specimen required	Test detects	Time taken to obtain result
<b>Agent detection</b>			
Real-time PCR	Whole blood (EDTA) Fresh tissue (spleen, lung and lymph nodes)	Viral RNA	4–5 hours
<b>Agent characterisation</b>			
Virus isolation and identification	Whole blood (EDTA) Fresh tissue (spleen, lung and lymph nodes)	Virus	1–3 weeks
Whole-genome sequencing	Virus isolates (or whole blood or tissue samples)	Virus genotype and serotype	5 days
<b>Serology</b>			
ELISA	Serum	AHS virus group antibody	4 hours
Virus neutralisation	Serum	Type-specific antibody	5 days

AHS = African horse sickness; EDTA = ethylenediaminetetraacetic acid; ELISA = enzyme-linked immunosorbent assay; PCR = polymerase chain reaction

Source: Information provided by CSIRO-ACDP, 2020 (refer to CSIRO-ACDP for most up-to-date information).

**Figure 2.1 Current approach to diagnostic testing for African horse sickness at CSIRO-ACDP**



<sup>1</sup> Ideally EDTA Blood or postmortem samples (spleen, lung or lymph node)

<sup>2</sup> Whole genome sequencing directly from clinical samples is only likely to be successful in strongly positive samples.

## 2.6 Resistance and immunity

Immunity to infection with AHS virus is largely serotype-specific: animals that recover from AHS develop strong immunity to the infecting serotype and partial immunity to some other serotypes (OIE 2019).

African donkeys and zebras exhibit strong innate immunity. The presence of antibodies in other wild animals, including African elephants and camels, is not completely understood.

Foals receiving colostrum from immune mares acquire passive immunity that lasts for up to 6 months. Exposure to circulating virus, notably serotype 9, during this time may provide ongoing immunity (Oura et al 2012).

## 2.7 Vaccination

[Vaccination may be considered as part of an integrated emergency response. However, current commercially available vaccines for use in endemic countries in 2021 are attenuated ('live') vaccines. A number of potential problems with using these vaccines means that they are unlikely to meet regulatory requirements for importation or emergency use in Australia. Vaccines in use in endemic countries prevent disease but not viraemia in vaccinated horses. Use of polyvalent vaccines could introduce additional attenuated AHS virus serotypes heterologous to the circulating field strain. Strains of virus derived from live attenuated vaccines have caused deaths in naive horses (Oura et al 2012), and reassortment and reversion to virulence have been reported (Weyer et al 2016). Suitable monovalent vaccines are unlikely to be available at the beginning of an outbreak. There is also a potential for reproductive disease, including teratogenic effects, in pregnant mares that are vaccinated with attenuated vaccines.

Inactivated vaccines have not been produced since 1990. Although production could be resumed if requested, this would involve considerable time delays.

If vaccination is used to protect equids from AHS, both horses and donkeys must be vaccinated, and a high level of coverage is required to prevent continuing outbreaks (Lord et al 1997).]

## **2.8 Treatment of infected animals**

There are no effective treatments for AHS, although supportive care may contribute to the recovery of some horses. If infected animals are to be treated, they must be housed in insect-proof enclosures for the duration of the infective period (40 days) to reduce the risk of virus transmission to competent insect vectors. Horses showing clinical signs should not be moved off-site for treatment. Apart from biosecurity concerns, affected horses may be unfit to travel because of compromised cardiac function.

## **2.9 Control overseas**

Movement controls on equids form a critical part of AHS control programs in South Africa, particularly restrictions on movements of horses between zones of different AHS status. An immediate movement ban was an important part of the response to an outbreak in the AHS-controlled area in Western Cape Province in South Africa in 2011, followed by blanket vaccination (Grewar et al 2013).

Annual vaccination using attenuated ('live') vaccines is practised in AHS-endemic areas in Africa.

In South Africa, two polyvalent vaccines (one trivalent and one quadrivalent) are available to immunise horses against all nine serotypes of AHS virus. Foals are vaccinated twice in the first year or two, to account for waning maternal antibodies, followed by annual vaccinations. Horses that have received three or more courses of vaccine are usually well protected against the disease (Coetzer & Guthrie 2004).

In Thailand in 2020, emergency vaccination commenced with a commercially available trivalent attenuated vaccine containing the serotype of the circulating field strain.

## 3 Implications for Australia

### 3.1 Potential pathways of introduction

African horse sickness (AHS) has a demonstrated ability to spread regionally and internationally. AHS could be introduced into Australia by infected vectors, infected hosts or vaccines, although these means of entry are strictly controlled.

AHS is spread between areas by the movement of infected animals or vectors. Serious outbreaks have occurred after infected animals were moved into areas containing favourable vectors and a susceptible horse population (Howell 1960, Rodriguez et al 1992). Australia does not import equids directly from countries or zones affected by AHS.

Windborne spread of infected vectors has been implicated in some outbreaks (Sellers et al 1977). Windborne spread of vectors infected with serotypes of bluetongue virus does occur from Asian countries to northern Australia (Eagles et al 2014). The occurrence of AHS in Thailand in 2020 increases the potential risk to Australia, and the risk would be increased further if AHS were to spread to countries closer to Australia. Winds from the north during the monsoon may lead to infected *Culicoides* midges arriving in northern Australia.

Australia implements a range of control mechanisms, including rigorous quarantine measures and disinsection of international aircraft, so the likelihood of introduction of AHS via infected *Culicoides* on international flights is low.<sup>7</sup>

Import and use of any AHS vaccine in Australia are prohibited. Any equine vaccines approved for import must originate from an approved source and undergo testing for the presence of adventitious viruses.

### 3.2 Social, economic and environmental effects

The horse industry in Australia is large, and diverse in structure, activity and function. It uses large areas of land, contributes to export earnings, and creates significant economic activity and employment in rural and regional communities. The size and economic impact of the racing sector are well documented,<sup>8</sup> but reliable and precise information on the relative importance of other sectors is difficult to obtain.

Although the effects will vary depending on the entry point and rate of spread, an outbreak of AHS is likely to result in a significant number of horse deaths, as well as an immediate export ban. An export ban will have a major effect on the thoroughbred racing industry and on the equine breeding industry because shuttle stallions (stallions that are moved between the Northern and Southern Hemispheres) will not be sent to Australia. A significant reduction in horse imports could also be expected, especially for horses temporarily imported for racing, competition and breeding. Even a limited outbreak could result in long-term restrictions on international trade in horses, horsemeat and genetic material unless Australia's major trading partners will accept an established containment zone (see Section 4.3.4) for AHS in Australia.

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<sup>7</sup> For further information on preventive measures, refer to *Animal health in Australia* reports (<https://animalhealthaustralia.com.au/industry-publications>) and the Australian Government Department of Agriculture, Fisheries and Forestry ([www.agriculture.gov.au/biosecurity](http://www.agriculture.gov.au/biosecurity)).

<sup>8</sup> Reports on the racing industry can be found at <http://nationalindustryinsights.aisc.net.au/industries/racing>.

The national movement of horses for racing, breeding, recreation, competition, stock work and tourism will also be disrupted.

Racing cancellations will affect income for governments, race clubs, owners, trainers, jockeys, farriers, bookmakers, race-club staff, horse transport companies, equine specialist veterinary services and wagering companies. This would result from loss of race meetings and betting turnover, lost gambling revenue to state governments, and forfeited stake money. Such impacts will be highest during the periods of major events. A broad range of ancillary service providers depend entirely for their livelihood on a normally functioning horse industry. Many others work part-time in occupations related to the horse industry.

Horse-related activities play an important part in the social amenity and recreation of many Australians. Uncertainty in approval, sourcing and availability of vaccine could create unrest among owners and inhibit the reporting of disease. Death of horses with distressing clinical signs would have a significant emotional impact on horse owners and create intense anxiety, as well as causing serious horse welfare issues.

An eradication program that results in destruction of horses, donkeys and zoo equids is likely to cause public outcry.

### **3.3 Critical factors for an Australian response**

- AHS virus causes high case fatality rates in horses. Horses will usually show severe disease, whereas disease may be milder in donkeys and zebras.
- AHS virus does not affect humans.
- AHS virus is not transmitted directly between animals; it is transmitted only via competent insect vectors.
- Competent vectors are likely to be present in Australia, and those that have a preference for feeding on horses could play a significant role in AHS virus transmission.
- Equids are primary and amplifying hosts, and populations of feral equids (especially donkeys) may provide ongoing sources of infection for vectors.
- Once AHS is introduced, movement of infected equids is the most likely means of spread of AHS virus to new areas.
- Dogs (and potentially dingoes) may be affected by eating meat from infected equids.
- Horses that survive infection do not develop carrier status. Serotype-specific antibodies are believed to persist for the life of the animal following infection.
- AHS virus does not survive outside the host or vector for long, and products (eg meat, hides) and fomites are not a risk for transmitting infection in the equid population.
- Laboratory tests are available in Australia that will detect AHS virus, including serotyping of the nine serotypes, within 24 hours of receipt of samples.
- Once established, AHS is most likely to occur in late summer or early autumn, due to increasing vector populations with warmer and wetter weather.
- If AHS were to become established in the feral equid population, eradication would depend on control of feral animals and vaccination of domestic horses (if vaccine is available and climatic conditions are suitable). Australia has very large feral donkey and horse populations in the north.
- Australian populations of equids have not been exposed to, or vaccinated against, AHS and are immunologically naive.

- If AHS becomes established in a sylvatic cycle in a region of Australia, incursions of AHS virus into local animal populations may be seasonal, and associated with changes in vector distribution, although some *Culicoides* species can tolerate a cooler environment.
- Overseas, movement controls on horses and vaccination form the core of control programs.
- Horses can be highly mobile, and restriction of movements is essential to stopping the spread of AHS virus. Accurate information about numbers, movements and locations of both domestic and feral horses and donkeys in Australia is not available.
- Many horses in Australia are not permanently identified (using brands, microchips, property identification codes or passports).
- Vaccines are not available in Australia. The commercially available polyvalent attenuated ('live') vaccines are unlikely to meet Australian regulatory requirements for animal vaccines.
- Control of vectors, other than short-term control in a limited area, is not recognised as a viable strategy.
- Stamping out of infected animals is not practised in endemic countries.
- Destruction of individual infected animals may be required for welfare reasons and to prevent further spread if affected equids cannot be protected from insect vectors.
- Destruction of horses in the absence of immediately available vaccines for disease control purposes will generate considerable public hostility.
- An AHS outbreak will have significant impact on international trade in equids.
- The World Organisation for Animal Health *Terrestrial animal health code* gives a maximum infective (viraemic) period of 40 days.

## 4 Policy and rationale

### 4.1 Introduction

African horse sickness (AHS) is a World Organisation for Animal Health (WOAH)–listed disease that has the potential for serious and rapid spread, and is important in the international trade of horses. Australia is a WOAH member country officially recognised as free from AHS. Australia’s AHS-free disease status would be suspended in the event of an incursion of AHS. AHS freedom could be reinstated (for part or all of the country) on submission of an application that fulfils all the WOAH requirements for recovery of official disease status.<sup>9</sup>

#### 4.1.1 Summary of policy

The default policy is to eradicate AHS. Eradication will be feasible if the disease is detected early in isolated animals and there are no infected vectors, if the disease occurs in a vector-free area, or if frosts are imminent in vector areas. If the disease occurs in an area containing competent vectors, eradication will be more difficult, and declared areas (restricted areas – RAs, and control areas – CAs) may be considered both to control the spread of AHS and to enable earlier resumption of movements of horses in unaffected parts of the country.

A combination of strategies will be used in the eradication or control of the disease, including:

- early recognition and laboratory confirmation of cases
- *establishment of declared areas* to facilitate outbreak management
- *movement controls* over horses and donkeys in declared areas to minimise the spread of infection
- an *epidemiological assessment* to determine the competent insect vectors, and establish whether feral equids are implicated in the spread of infection and whether ecologically suitable niches may be present that favour formation of an ongoing reservoir population
- *protection* of equids from vectors
- *prevention* of vector access to viraemic equids
- judicious *destruction of infected equids*, with salvage of individual infected equids subject to risk assessment
- judicious destruction of feral equids within the RA<sup>10</sup>
- *tracing and surveillance* (based on epidemiological assessment) to determine the source and extent of infection (including, as necessary, in feral horses) and subsequently to provide proof of freedom from the disease
- *vector control* in selected areas (eg around stables)
- facilitation of *access to efficacious vaccines* (which currently are not available in Australia for horses)
- where appropriate, *vaccination* to establish immune populations, to support control or management of AHS establishment and spread
- timely *information, negotiation* with trading partners and *zoning* plans, as necessary, to limit impacts on trade

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<sup>9</sup> <https://www.woah.org/en/disease/african-horse-sickness>

<sup>10</sup> Guidance on disposal options and methods can be found in the **AUSVETPLAN operational manual Disposal**.

- a *public awareness* campaign to inform the public, encourage rapid reporting of suspected cases, and facilitate cooperation from industry and the community.

An outbreak of AHS could have major economic and social impacts on individuals, the horse industry and governments through mass mortalities, and disruption of horse racing and other equestrian activities. Even if it was confined to a small area, there would be severe disruption of horse exports unless AHS-free zones were established and accepted by trading partners. A significant reduction in horse imports could also be expected while exports were halted, especially for horses imported for short-term racing, competition and breeding.

#### **4.1.2 Case definition**

For the purposes of this response strategy, a case of AHS is defined as laboratory-confirmed infection with AHS virus (with or without clinical signs).

##### **Notes:**

- Positive serology in the absence of genome or antigen does not constitute a case but warrants further investigation to determine if there is evidence of infection.
- At the time of an outbreak, revised or subsequent case definitions may be developed (with the agreement of the Consultative Committee on Emergency Animals Diseases – CCEAD).
- AUSVETPLAN case definitions guide when a response to an emergency animal disease (EAD) incident should be undertaken. AUSVETPLAN case definitions do not determine when international reporting of an EAD incident is required.

#### **4.1.3 Cost-sharing arrangement**

In Australia, AHS is included as a Category 3 emergency animal disease in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses (EAD Response Agreement).<sup>11</sup> When cost sharing of the eligible response costs of an incident is agreed, Category 3 diseases are those for which costs will be shared 50% by government and 50% by industry.

#### **4.1.4 Criteria for proof of freedom**

If AHS became endemic in northern Australia, efforts to restore trade should be directed towards proving the regional freedom of other areas.

The questionnaire for WOAHP-recognised official country freedom from AHS and the WOAHP *Terrestrial animal health code* (Articles 12.1.11–12.1.13) provide the conditions for establishing a recognised free zone, proof of freedom and restoration of freedom. These include an intensive surveillance program for virus and vectors within both the infected and free zones.

International trading partners may impose additional conditions.

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<sup>11</sup> Information about the EAD Response Agreement can be found at <https://animalhealthaustralia.com.au/eadra>.

### 4.1.5 Governance

Governance arrangements for the response to EADs are outlined in the **AUSVETPLAN Overview**.

Information on the responsibilities of a state coordination centre and local control centre is available in the **AUSVETPLAN management manual Control centres management (Parts 1 and 2)**.

## 4.2 Public health implications

AHS has no public health implications.

## 4.3 Control and eradication policy

The eradication strategy would be based on quarantine and movement controls for susceptible animals in the RA and CA during the outbreak and the following period, protection of equids from vectors, and vaccination (if available). Other strategies that may be used include vector controls and destruction of infected animals, particularly where the animals cannot be appropriately protected from vectors.

Movement controls are an important part of an AHS control and eradication strategy. Historically, the introduction of AHS to new areas of the world has been by movement of viraemic equids (Carpenter et al 2017). Similarly, movements of equids have been implicated in the reintroduction of AHS into the AHS-controlled zone of South Africa (Grewar et al 2013).

It is imperative to prevent vector access to viraemic equids, to avoid amplifying AHS virus in the vector population. Salvage of individual infected horses should be subject to risk assessment, based on the availability of protection against vectors and the likelihood of survival of the animal. It may be necessary to euthanase infected horses on welfare grounds; viraemic horses that cannot be isolated from vectors should also be destroyed.

Because of the individual value of some horses and the emotional attachments associated with horse ownership, close liaison with industry, horse owners and the media will be needed.

### 4.3.1 Epidemiological assessment

Epidemiological investigation or assessment draws on multiple sources of information to build understanding of the disease and how it is behaving in an outbreak. This helps inform response decision making.

In the initial response, the key objectives for an epidemiological assessment will be to identify:

- the spatial distribution of infected and free domestic and wild animal populations
- the vectors involved and their distribution
- the source of infection
- pathways of spread and their relative priority
- the likely extent of spread and size of the outbreak, using modelling where available
- risk factors for the presence of infection and susceptibility to disease.

Epidemiological assessment, and tracing and surveillance activities (see Section 4.3.3) in an EAD response are interrelated activities. Early findings from tracing and surveillance will be inputs into

the initial epidemiological assessment. The outcomes of the initial epidemiological assessment will then guide decisions on subsequent tracing and surveillance priorities.

The outcomes of the epidemiological assessment will also be used initially to determine the feasibility of eradication versus long-term control and so guide the selection of appropriate response measures.

Ongoing epidemiological assessment is important for any EAD response to aid evaluation of the continued effectiveness and value of response measures, and assessment of the progress of disease control measures. The assessment will consider the outcomes of tracing and surveillance activities, and will contribute evidence to support any later claims of disease freedom.

### **4.3.2 Quarantine and movement controls**

See Section 5 for details on declared premises and areas, and Section 6 for recommended quarantine and movement controls.

#### **Quarantine**

Quarantine will be immediately imposed on all premises and areas on which infection is either known or suspected.

Premises will be declared (see Section 5.3). An RA and a CA will be declared around the infected premises (IPs).

Decisions on placing the following premises in quarantine should be based on risk assessment:

- dangerous contact premises (DCPs)
- suspect premises (SPs)
- trace premises (TPs).

The risk assessment should take into consideration:

- the number, species and age of animals present, and the role of these species in the epidemiology of AHS
- the potential presence and nature of other contaminated materials (noting that fomites are not important in the spread of AHS)
- the ongoing risk of AHS transmission on and from the premises
- the need for additional disease control measures (eg vector-protected housing) on the premises to control AHS.

The presence of dead-end hosts alone – that is, dogs (whether infected or not) – would not be sufficient to warrant placing a premises under quarantine.

When imposed, quarantine will remain in place until disease control measures on the premises have been completed and the ongoing risk of disease has been assessed (see Section 5.4 for guidance on reclassifying premises).

## **Movement controls**

Movement controls are best implemented through the declaration of declared areas and application of movement control conditions by permit. As a general principle, the aim of movement controls is to reduce the spread of disease by preventing the movement of infected animals, infected animal products and infected vectors (where relevant for the disease), and by allowing movements that pose minimal risk.

The results of the epidemiological investigation will determine whether continuing quarantine and movement controls are warranted. It is important to be aware of possible trade concerns about the movement of animals from the vicinity of the outbreak area to free areas, even when such movements carry low disease risk. Any horses to be moved from the vicinity of outbreak areas should be identified and traceable. Affected jurisdictions may wish to act conservatively until the epidemiological investigation is complete and the full extent of the disease risk and the trade risk is known.

Movement controls will be maintained to some degree until the disease is either eradicated, contained (with the aim of eradication) or declared endemic.

Section 6.4 provides details on movement controls for live animals, reproductive material (semen and in vivo-derived embryos), animal products and other items.

### **4.3.3 Tracing and surveillance**

Guidance on tracing and surveillance can be found in the **AUSVETPLAN guidance document *Tracing and surveillance***.

Tracing and surveillance will need to be undertaken quickly to determine the source of the infection, to identify the risk premises and to define as closely as possible the extent of the infection. A full epidemiological investigation will be undertaken involving both vector and virus surveys, detailing environmental and ecological conditions leading up to the outbreak, the stage of the vector season (if present), and an assessment of the likelihood of continuing vector activity and future seasonal outbreaks.

Feral horse, donkey, zoo equid and camel populations need to be included in any surveys if they are present in the area where the disease occurs.

#### **Tracing**

Trace-back and trace-forward must extend for 40 days, from the time of the first clinical signs to the time that quarantine was imposed. It will involve tracing susceptible animals from the IP(s). Tracing should consider vector activity; tracing potentially infected animals moving to areas with competent but uninfected vectors will be a high priority. Any suspect horsemeat must be traced.

#### **Surveillance**

To demonstrate proof of freedom, a major program of surveillance for virus and vectors will need to be undertaken during the initial investigations and following the last cases (see Section 7.1). Meteorological data may need to be considered in developing a surveillance plan, to help predict vector spread.

#### **4.3.4 Zoning for African horse sickness**

Where it is not possible to establish and maintain disease freedom for the entire country, establishing and maintaining disease-free subpopulations through zoning<sup>12</sup> may be considered. The WOAH Terrestrial Code describes recommendations for establishment and WOAH recognition of an AHS containment zone in a previously free country.

In the case of a limited disease outbreak, declared areas (RAs and CAs) may be established around the areas where the outbreak is occurring, with the dual purposes of disease control or eradication within the areas, and maintaining or re-establishing the disease-free status of the rest of the country outside the areas. For AHS in Australia, containment may be an important prelude to eradication if the virus is maintained for a time in local vector and equid populations.

All zoning applications for WOAH recognition would need to be prepared by the Australian Government in conjunction with the relevant jurisdiction(s) and agreed to by the CCEAD. Recognition of zones must still be negotiated between the Australian Government and individual overseas trading partners.

Agreements between trading partners take time to develop, consider and finalise, because of the need to provide detailed information on activities such as biosecurity, surveillance, traceability and diagnostics to support the approach that is developed. An importing country will need assurance that its animal health status is not compromised if it imports from an established disease-free zone in Australia. Trading partners may not accept a zoning proposal, regardless of the information provided. Eradication of disease may be achieved before zoning applications are finalised.

The WOAH general guidelines for zoning and compartmentalisation are in Chapter 4.4 of the WOAH Terrestrial Code.

#### **4.3.5 Biosafety and biosecurity for personnel**

AHS is not known to have any public health implications; however, some of the differential diagnoses for AHS (eg infection with Hendra virus, anthrax) do have public health implications. For this reason, response personnel working in the field should consider state and territory protocols for these diseases and may need to wear appropriate personal protective equipment (PPE). The PPE should be chosen based on the assessed level of risk, the task and the animal species. Postmortem examination of affected horses should be conducted with consideration of Hendra virus and/or anthrax protocols, or after exclusion of these diseases.

Hand hygiene should be undertaken after removing PPE.

#### **4.3.6 Biosecurity for equipment**

AHS is not transmitted by most fomites, but equipment contaminated with blood from viraemic animals (eg needles, postmortem equipment) may pose a potential risk to susceptible animals (eg through needlestick injuries). Disposable equipment contaminated with blood should be disposed of in a biosecure manner. Reusable equipment contaminated with blood should be decontaminated (see Section 4.3.13).

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<sup>12</sup> With zoning, disease-free subpopulations are defined primarily on geography.

Although there are no additional AHS-specific recommendations, maintenance of general biosecurity measures is recommended in all EAD responses.

### **4.3.7 Animal welfare**

Guidance on managing animal welfare can be found in the **AUSVETPLAN operational manual *Livestock welfare and management***.

Following risk assessment, salvage of individual infected equids may be attempted if exclusion of vectors is possible, recognising the low likelihood of survival of horses with pulmonary and severe cardiac forms of AHS. It may be necessary to euthanase infected horses on welfare grounds. Viraemic equids that cannot be isolated from vectors may also need to be destroyed to prevent continued spread of virus to *Culicoides* vectors.

### **4.3.8 Vaccination**

Vaccination will be considered in the control and eradication of AHS if a suitable vaccine is available, the virus is present in the vector population and the disease becomes widespread. All vaccinated animals must be permanently identified, and both horses and donkeys must be vaccinated.

Vaccine would be used on noninfected domestic equids in the RA and possibly the CA. Early and widespread vaccination will only be possible if a current vaccine (incorporating the serotype of the circulating virus) is available overseas that can satisfy Australian biosecurity requirements.

If an outbreak of AHS occurs, one of the first tasks will be to initiate action to secure an effective vaccine, if available.

### **4.3.9 Treatment of infected animals**

Treatment of animals infected with AHS virus may be attempted if the risk of virus transmission from viraemic animals to vectors can be effectively eliminated (see Section 2.8 and Appendix 2).

### **4.3.10 Treatment of animal products and byproducts**

Meat, semen and embryos are the major animal products affected by AHS that are of concern. Meat from an RA should be destroyed or heat treated in the early part of the outbreak. As the situation becomes clearer, meat from susceptible animals from the RA may be used if subjected to effective heat treatment.

The risk from semen and embryos has not been determined. These materials should not be collected from animals within the RA or animals traced from the RA. Products in storage may be assessed on their merits, taking into consideration the time of collection and other factors that might cause contamination of samples.

#### **4.3.11 Destruction of animals**

Destruction plans should be developed for each premises on which animals may be destroyed.

Guidance on destruction methods can be found in the **AUSVETPLAN operational manual *Destruction of animals***.

#### **4.3.12 Disposal of animals, and animal products and byproducts**

Disposal plans should be developed for each quarantined premises. Guidance on disposal options and methods can be found in the **AUSVETPLAN operational manual *Disposal***.

Carcasses and other materials from IPs should be disposed of in a manner that will prevent access to infectious material by dogs.

#### **4.3.13 Decontamination**

Decontamination plans should be developed for each premises to be decontaminated. General guidance on decontamination can be found in the **AUSVETPLAN operational manual *Decontamination***.

AHS virus can survive in some products, such as blood, for some time (see Section 2.4.2), so it will be necessary to ensure that sanitary conditions are maintained in the environment and that fresh blood is removed. Veterinary equipment must be cleaned and sterilised after use on infected animals. Fomites are not implicated in the natural transmission of AHS virus. Vehicles should be cleaned and treated for vectors if leaving the RA.

On premises, no decontamination precautions, other than normal hygienic measures, are necessary.

#### **4.3.14 Wild animal management**

Wild horses and donkeys are likely to be infected with AHS virus if competent vectors are present and shown to be widespread.

An intensive control program to control wild populations of susceptible animals in the vicinity of an outbreak may be necessary to reduce the risk of spread. These animals should be surveyed to determine whether the virus has spread into the feral population. General guidance can be found in the **AUSVETPLAN operational manual *Wild animal response strategy***.

#### **4.3.15 Vector management**

Vector-protected housing, external application of insect repellent to individual animals and environmental modification to reduce vector breeding sites are effective measures in limiting the spread of virus by vectors.

##### **Surveillance**

With input from entomologists, a vector monitoring program should be implemented to identify the range of *Culicoides* species that may transmit infection. The vector species implicated will determine the potential extent of spread of AHS within Australia, and the control measures to be used. Knowledge

of the ecology of different *Culicoides* species – distribution, breeding habits, resting behaviour and host-orientated responses – will be important when formulating effective recommendations to protect horses from attack by *Culicoides* midges. For instance, *C. bolitinos*, a known vector of AHS virus in other countries, will enter stables (endophilic), so stabling animals is only effective if stables are adequately enclosed, whereas *C. imicola* is active outside stables (exophilic) (Meiswinkel et al 2000).

A range of collection techniques, including carbon dioxide-baited light traps, truck traps and larval sampling, are used for vector surveillance. Collections should be stored in a suitable condition for later sorting and identification.

Insect collections can be subjected to conventional virus isolation procedures, but these are expensive, logistically difficult and too time-consuming to be used for routine surveillance. Successful virus-specific surveillance of large pools of *Culicoides* is becoming more feasible using polymerase chain reaction (PCR) technology. Although the specificity of virus isolation and PCR is high, the sensitivity of these techniques is inadequate for routine use. Sensitivity can be improved by increasing the density of traps where the risk justifies the cost.

In risk areas, insects collected under sentinel programs for other orbivirus diseases should also be tested for AHS virus. Currently available *Culicoides* monitoring systems could be augmented by establishing additional monitoring sites. Information obtained from serological monitoring of sentinel animals such as donkeys will indicate whether virus isolation from, or PCR testing of, *Culicoides* is necessary. Low infection prevalence in midge populations may reduce the sensitivity of PCR testing for AHS virus in vectors. In one laboratory study (de Waal et al 2016), the limit for detection of AHS virus by PCR was 1 freshly infected midge per pool of 25 *Culicoides* midges. In practice, it may be possible to analyse larger pool sizes in the field.

Refer to Appendix 3 (and the **AUSVETPLAN resource document *Understanding and responding to Culicoides***).

### **Vector control**

The control of widespread *Culicoides* vector species will be challenging, if not impossible. Expert advice from an entomologist should be obtained to guide the development of a targeted control program to limit transmission. The potential human health and environmental effects of widespread insecticide use should also be considered.

### **Application of insecticide to the environment**

Aerial spraying and ground application of insecticide as ultra-low-volume fogs are unlikely to be useful for controlling midge populations and may cause damage to the environment, particularly in watercourses. However, they may be considered in some circumstances.

### **Application of insect repellants and insecticides to horses**

Repellents are substances that deter the approach of insects. Insecticides are substances that kill exposed insects. Topical application of repellents to at-risk animals has the potential to reduce the risk of exposure. Diethyltoluamide (DEET) is considered the gold-standard repellent (Page et al 2009, Harrup et al 2016). Neem-based formulations also have the potential to reduce landing and feeding by *Culicoides* midges (Harrup et al 2016). Various DEET repellents are registered for use on livestock in Australia, including some that are specifically registered for use on horses or dogs; others are more versatile, for use on cattle, pigs, horses and animal housing. Some registered products contain both repellents and insecticides.

Insecticides applied topically to animals could have beneficial effects through reducing the survival rates of exposed midges and thereby reducing the risk of onward transmission; however, they have not been found to reduce the risk of an animal being bitten (Harrup et al 2016, Murchie et al 2019).

More detail can be found in the **AUSVETPLAN resource document *Understanding and responding to Culicoides***.

### **Treatment of livestock with macrocyclic lactones**

Treatment of horses with macrocyclic lactones (MLs), such as ivermectin, is unlikely to prevent *Culicoides* midges feeding on blood, but may prevent ongoing transmission by a vector that becomes infected from a blood meal. The efficacy of MLs for this purpose in horses is uncertain, since near-toxic (to the horse) doses may be needed to have an effect on *Culicoides* midges (Robin et al 2016). Use of injectable MLs in horses is off-label.

Treatment of cattle and sheep in the RA, or even on the IP and neighbouring premises, with either a systemic insecticide such as ivermectin or a topical insecticide may reduce the population of some potential vector species, particularly *C. brevitarsis*. However, these chemicals have withholding periods that need to be observed. For example, for ivermectin administered subcutaneously, the withholding period is 42 days for meat for human consumption, and 28 days for milk and milk products. It is therefore unlikely that this action would be taken to reduce *Culicoides* populations across a large area.

### **Housing**

Where animals are held in stables, the interior should be treated with an appropriate insecticide. If possible, animals on open pasture should be moved to stables or some form of covered shed, which should be treated with insecticide. Sheds enclosed by insecticide-impregnated mesh are ideal, but even open-sided sheds may help to limit exposure, especially to exophilic biting midges. Application of insecticides (such as pyrethroids) to mesh used to cover stable windows and openings can increase their effectiveness at preventing entry of *Culicoides* midges (Page et al 2014, Baker et al 2015). Where animals remain on open pasture, they should be rugged and/or treated with a suitable insect repellent to reduce exposure to biting insects.

All vehicles leaving the site of the outbreak should have the interior treated with an aerosol insecticide to kill live flying insects and prevent spread of potential vectors. For further details of vector monitoring and control, see the **AUSVETPLAN resource document *Understanding and responding to Culicoides***.

In an outbreak, horse owners should try to reduce the risk of exposure of their horses to vectors [until protective immunity of horses can be achieved by vaccination]. Methods to prevent *Culicoides* from biting horses have been reviewed by Robin et al (2016).

Control measures that might help to reduce midge contact with horses (although they will not eliminate the risk of infection) include:

- housing horses during peak periods of vector activity (between dusk and dawn)
- erecting appropriate physical barriers at entry and exit points to housing (eg double-door entry–exit system)
- turning off lights inside stables at night
- screening building openings with 80% shadecloth or midge mesh impregnated regularly with an appropriate insecticide (Meiswinkel et al 2000, Baker et al 2015)
- using automatic insecticide dispensers to eliminate vectors in stables
- applying a vector repellent such as DEET to preferred midge biting sites (ie head, neck, back, tail base and belly) twice a day
- spraying stable walls with appropriate residual insecticides
- using physical protection – for example, rugging and hooding horses in cypermethrin-treated material (if climatically appropriate)

- eliminating *Culicoides* breeding sites on, and immediately adjacent to, the premises by management of manure, other organic material and stagnant water
- moving horses to higher, windy ground likely to have lower *Culicoides* populations, if such movement is permitted
- separating horses from other stock that midges are also attracted to (ie goats, sheep and cattle); keeping horses with these animals may increase the risk of midge attack.

#### 4.3.16 Public awareness and media

Guidance on managing public information can be found in the **AUSVETPLAN resource document *Biosecurity incident public information manual*** [to be updated].<sup>13</sup>

Public awareness and industry engagement will support a cohesive response. The communications strategy should include mechanisms for raising awareness in owners of horses, donkeys and dogs. It should include strategies for communication with other groups such as petting zoos, school farms, urban and peri-urban horse owners, riding stables, recreational horse groups, and racing organisations.

Key topics to be covered in public information messaging will include advice on:

- movement restrictions on live susceptible animals
- the modes of transmission of AHS between animals
- the safety of food and other products derived from animals
- *Culicoides* control, and preventing animal exposure to midge bites
- signs of disease in horses, donkeys and possibly dogs, and how to report suspected infection in animals
- where to find more information on the response and the control measures being used
- the benefits of vaccination (if available) in horses, and how vaccine may be obtained.

National coordination of public information and engagement messaging in the event of an AHS incident in Australia may occur through activation of the National Biosecurity Communication and Engagement Network.<sup>14</sup> The network will coordinate animal health information, and liaise with public health and environmental agencies.

#### 4.3.17 Other strategies

Vaccination and zoning in accordance with WOAH guidelines will be the selected strategies if eradication takes longer than expected or if AHS becomes endemic in regions of Australia.

#### 4.3.18 Stand-down

Stand-down of the response will occur when the National Management Group formally declares the outbreak over. This may be when it decides that AHS has been controlled or eradicated, or when control or eradication is no longer considered feasible or practicable.

<sup>13</sup> BIPIM Part 1 Public Information Policy on the AUSVETPLAN webpage (<https://animalhealthaustralia.com.au/ausvetplan>).

<sup>14</sup> Previously known as the Primary Industries National Communication Network (NCN). More information is available at [www.outbreak.gov.au/about/biosecurity-incident-national-communication-network](http://www.outbreak.gov.au/about/biosecurity-incident-national-communication-network).

## 4.4 Other control and eradication options

If control and eradication of AHS using the strategies outlined above is not feasible, a long-term control program may need to be developed through consultation between Australian governments and the horse and donkey industries. The involvement of other stakeholders (eg cattle industry, parks and wildlife agencies, zoos) may also be warranted, depending on the circumstances (particularly the location) of the incident.

## 4.5 Funding and compensation

Details of the cost-sharing arrangements can be found in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses.<sup>15</sup> Details of the approach to the valuation of, and compensation for, livestock and property in disease responses can be found in the **AUSVETPLAN operational manual *Valuation and compensation***.

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<sup>15</sup> <https://animalhealthaustralia.com.au/eadra>

## 5 Declared areas and premises

When an emergency animal disease (EAD) is first suspected, the premises involved would undergo a clinical and/or epidemiological investigation. If the case definition, as defined in the relevant AUSVETPLAN response strategy, is met (ie the index case<sup>16</sup>), the relevant chief veterinary officer (CVO) or their delegate will determine the premises classification and may declare the premises an infected premises (IP).

After the identification of the first IP, a restricted area (RA) and a control area (CA) may be declared.<sup>17</sup> All premises within these areas will be classified.

At the beginning of an EAD incident, the initial premises classifications would be IP, at-risk premises (ARP), premises of relevance (POR), unknown status premises (UP) and zero susceptible species premises (ZP).

Any premises within the RA or CA will have only one classification at any one time. After an epidemiological investigation, clinical assessment, risk assessment or completion of control measures, a premises may be reclassified.

Once the first IP has been identified, intelligence gathering through veterinary epidemiological investigations would quickly lead to the identification of suspect premises (SPs) and trace premises (TPs). These would be high priorities for follow-up investigation by the relevant state or territory authorities. In a worst-case scenario, an SP could become an IP; therefore, SPs need to be investigated as a matter of very high priority. Similarly, investigation and risk assessment of a TP might identify it as an IP, dangerous contact premises (DCP) or dangerous contact processing facility (DCPF). An SP or TP might also be assessed as negative and qualified as SP-AN or TP-AN, and eventually reclassified as an ARP, POR or ZP.

All premises classifications are subject to change as a result of a modification in the case definition(s) or investigation(s) as the incident response proceeds.

Classifications should be applied with information needs of managers in mind. They should assist managers to monitor and report progress. Premises classifications to be used should be agreed early in a response, so that control centre personnel can apply the correct and consistent classifications and definitions from the outset of the investigation and response.

### 5.1 Declared areas

Maintaining movement restrictions on areas for long periods has important implications for resource management, animal welfare, business continuity, and socioeconomic impacts on producers and regional communities.

During the course of an EAD response, it may become necessary for a CA or RA to be expanded as additional geographical areas or new foci of infection are identified. Later in the response, as control is achieved, mechanisms for gradually reducing the size of the CA and RA can be introduced.

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<sup>16</sup> The first case to come to the attention of investigators

<sup>17</sup> This is invariably the case with highly contagious diseases (eg foot-and-mouth disease, equine/avian/swine influenza, classical swine fever) but may not apply to less contagious diseases (eg Hendra virus, anthrax, Australian bat lyssavirus).

Detailed guidelines for declared areas are provided in the **AUSVETPLAN guidance document *Declared areas and allocation of premises classifications in an emergency animal disease response***.

### **5.1.1 Restricted area (RA)**

The borders of the RA should be based on risk assessment (see below). If competent vectors are known to exist, the RA borders should be at least 80 km<sup>18</sup> from the boundary of the IPs. They should encompass all IPs and DCPs, and include as many SPs, TPs and DCPFs as practicable. Based on risk assessment, the RA is subject to intense surveillance and movement controls. The purpose of the RA is to minimise the spread of the EAD. The RA can have an irregular perimeter, provided that the boundary is initially an appropriate distance from the nearest IP, DCP, DCPF, SP or TP. Multiple RAs may exist within one CA. The risk assessment should consider:

- likely local known competent vector species, and their distribution and expected dispersal
- the known distribution of infection
- the length of time infection is thought to have been present in the area and therefore where subclinical infection may be present (eg in feral equid populations)
- the location and distribution of populations of susceptible animals in the area and patterns of their movements
- prevailing weather conditions (and therefore the expected persistence and dispersal of vectors)
- the location of key elements in industry supply chains
- the impacts on the industry of the disease control measures compared with the expected benefits of disease control
- local land use (eg presence of national parks)
- known characteristics of African horse sickness (AHS) virus
- confidence in the accuracy of available information.

### **5.1.2 Control area (CA)**

A CA is a legally declared area where the disease controls, including surveillance and movement controls, applied are generally of lesser intensity than those in an RA (the limits of a CA and the conditions applying to it can be varied during an incident according to need).

A CA is a disease-free buffer between the RA and the outside area (OA). Specific movement controls and surveillance strategies will be applied within the CA to maintain its disease-free status and prevent spread of the disease into the OA.

An additional purpose of the CA is to control movement of susceptible livestock for as long as is necessary to complete tracing and epidemiological studies, to identify risk factors and forward and backward risk(s).

The CA will be a larger declared area around the RA(s) – initially, possibly as large as the state or territory in which the incident occurs – where restrictions will reduce the risk of disease spreading from the RA(s). The boundary of the CA should be at least 100 km from the boundary of the RA(s). It may be defined according to geography, climate and the distribution of relevant wild (including feral)

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<sup>18</sup> This distance is based on the ability of *Culicoides* to travel long distances, and recognises that the initial incursion of African horse sickness into Australia will most likely be in the north of the country, where properties are very large, and thus the initial case may not be detected immediately.

animals and vectors. The boundary will be adjusted as confidence about the extent and distribution of the incident increases.

## 5.2 Other areas

It is possible that other types of areas (eg vaccination area, surveillance area), which are not necessarily legally declared, may be used for disease control purposes in some jurisdictions.

## 5.3 Premises classifications

The status of individual premises will be declared after an epidemiological risk assessment has been completed.

Based on the disease risk they present, the highest priorities for investigations are IPs, DCPs, DCPFs, SPs and TPs.

In a disease outbreak, not all classifications may be needed. Premises classifications are mutually exclusive – that is, a given premises can have only one classification at any given time. After an epidemiological investigation, clinical assessment, risk assessment or completion of control measures, a premises may be reclassified.

### 5.3.1 Premises status classifications

For AHS, the premises classifications to be used are:

- infected premises (IP)
- suspect premises (SP)
- trace premises (TP)
- dangerous contact premises (DCP)
- dangerous contact processing facility (DCPF)
- approved processing facility (APF)
- approved disposal site (ADS)
- at-risk premises (ARP)
- premises of relevance (POR)
- resolved premises (RP)
- unknown status premises (UP)
- zero susceptible species premises (ZP).

### 5.3.2 Qualifiers

Please also refer to the **AUSVETPLAN guidance document *Declared areas and premises classifications*** for more detail on qualifiers.

For AHS, the qualifiers to be used are:

- assessed negative (AN)
- sentinels on site (SN)
- vaccinated (VN).

## 5.4 Reclassifying premises and previously declared areas

### 5.4.1 Reclassifying premises

For the purposes of this response strategy, unless otherwise stated, the recommended minimum quarantine period is 40 days from the confirmation of the last positive case on the premises, if there are surviving equids. If vectors are still active in the area, infected equids remain on the premises and appropriate vector control has been instituted, an IP may be reclassified as an ARP.

### 5.4.2 Reclassifying previously declared areas

The lifting of restrictions in declared areas is managed by jurisdictions according to their local legislation, regulations and processes.

The key principles for reclassifying a previously declared area during a response should include the following, noting that not all will be relevant for some diseases:

- The area should be epidemiologically distinct from other declared areas.
- All TPs and SPs have been investigated and reclassified, and all IPs, DCPs and DCPFs in the area have been reclassified as RPs (or APFs). (This may not be possible if competent vectors, hosts and infected reservoir populations remain in the declared areas.)
- All tracing and surveillance associated with EAD control have been completed satisfactorily, with no evidence or suspicion of infection in the area.
- An approved surveillance program has confirmed no evidence of infection in the RA (see below).
- For vector-borne diseases, vector monitoring indicates that vectors are not active.

Lifting of restrictions is a process managed by the relevant CVO under jurisdictional legislation and consistent with the most current agreed Emergency Animal Disease Response Plan. When the appropriate conditions are satisfied, an affected jurisdiction can, in consultation with the Consultative Committee on Emergency Animal Diseases (CCEAD), reduce the size of either or both the CA and RA, or lift all restrictions as surveillance and monitoring indicate change in risk. This is not straightforward for a vector-borne disease such as AHS. Jurisdictions should be able to present documented evidence that the appropriate conditions have been met.

If more than one jurisdiction is affected, each will use its own appropriate legal jurisdictional mechanisms to lift the declaration of the RA or CA, coordinating with each other and consulting with the CCEAD to ensure wide communication and coordination.

## 6 Movement controls

### 6.1 Principles

The principles for the recommended quarantine practices and movement controls are as follows:

- Containment and eradication of African horse sickness (AHS) is the highest priority. Therefore, 'normal business movements' are not allowed.
- Live equids pose the greatest risk of disease spread; therefore, their movements from all premises with susceptible animals within the restricted area (RA) and control area (CA) must be strictly controlled.
- The outside area (OA) should remain as 'clean' as possible. Therefore, movement of equids from the RA to the OA is prohibited, and movement of products is generally prohibited. Movement of animals and products from the CA to the OA will also be restricted, and for AHS may be prohibited.
- Trace premises (TP) and suspect premises (SP) are temporary classifications, and every effort should be made to resolve the status of these premises as soon as possible.
- The numbers of susceptible animals within the RA should be minimised. Therefore, movements of animals into the RA will be limited and usually for slaughter only.
- Movement restrictions are more stringent within the RA than within the CA, and will be more stringent in the early stages of the response.
- Movement controls may be varied during a response from those listed here. However, this will involve a variation to the agreed Emergency Animal Disease Response Plan, with endorsement by the Consultative Committee on Emergency Animal Diseases (CCEAD) and the National Management Group.
- Recommended movement controls apply to any movement off a premises, whether on foot or by vehicle, that involves either public or private land.
- All movement control matrixes and narratives are for guidance.
- Application for a movement permit does not automatically mean that one will be granted.
- In emergency or exceptional circumstances, any proposed movement may be considered by the jurisdictional chief veterinary officer (CVO) on a risk-assessed case-by-case basis.
- Interstate movements will need to meet the import requirements of the receiving jurisdiction.

### 6.2 Guidelines for issuing permits

In an emergency animal disease (EAD) event, quarantine and movement controls must strike a balance between quick and effective disease control and business continuity.

Recommended biosecurity and movement controls in each AUSVETPLAN response strategy provide guidance on which movements can be allowed and under what conditions. This is based on an analysis of the disease risks that are presented by a specific movement, of a specific commodity, at a specific time during the EAD response phase. Each disease strategy will indicate whether a proposed movement is:

- allowed (under normal jurisdictional, including interstate, requirements)
- prohibited – except under the conditions of a general, special or emergency permit
- prohibited.

Permits may not be available until the relevant CVO provides approval for movements, and this may not be available in the early stages of a response. When assessing risk for the purposes of issuing a permit, the elements to consider may include:

- sources of risk
  - risk material (eg live or dead susceptible animals, semen, embryos, meat, meat products)
  - location of source and destination premises
  - fate at destination premises (eg for slaughter)
  - current vector activity
  - organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
  - proposed use of the animals
  - proposed transport route
  - vaccination status of the animals, if relevant
  - treatment of animals and vehicles to prevent concurrent movement of vectors, if relevant
  - security of transport
  - security and monitoring at the destination
  - environment and natural events
  - community and human behaviour
  - risk of sabotage
  - technology
  - regulations and standards
  - available resources for compliance and enforcement
- areas of impact
  - livestock health (health of affected species, including animal welfare)
  - human health (including work health and safety)
  - trade and economic impacts (including commercial and legal impacts)
  - environmental impacts
  - organisational capacity
  - political impacts
  - reputation and image
- proposed risk treatment measures
  - vaccination
  - destruction of animals
  - protection of animals from vectors
  - processing of product
  - disinfection or other treatment of animals, vehicles and fomites
  - vector control, if relevant
  - security
  - communication.

## 6.3 Types of permits

Permits are either general or special. Emergency permits are a form of special permit. Permits are legal documents that describe the animal(s), commodities or things to be moved, the origin and destination, and the conditions to be met for the movement. Either type of permit may include conditions. Once permit conditions have been agreed from an operational perspective, all permit conditions must be met for every permit. Both general and special permits may be in addition to documents required for routine movements between or within jurisdictions (eg health certificates, waybills, consignment notes, National Vendor Declarations).

### General permit

General permits (GPs) are used for lower-risk movements, and create a record of each movement to which they apply. They are granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or gazetted inspector of stock. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed or electronic version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. GPs may not be available until the relevant CVO gives approval for general movements, and this may not be available in the early stages of a response.

### Special permit

Special permits (SpPs) are issued by the relevant government veterinarian or gazetted inspector of stock. They are used for higher-risk movements, and therefore require formal application and individual risk assessment. SpPs describe the requirements for movement of an animal (or group of animals), commodity or thing, for which a specific assessment has been conducted by the relevant government veterinarian or gazetted inspector of stock. A printed or electronic version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements.

### Emergency permit

An emergency permit is an SpP that specifies strict legal requirements for an otherwise high-risk movement of an animal, to enable emergency veterinary treatment to be delivered, to enable animals to be moved for animal welfare reasons, or to enable any other emergency movement under exceptional circumstances. These permits are issued on a case-by-case basis under the authorisation of the relevant CVO.

### Other movement requests

Movements not reflected within any of the movement control matrixes or narratives may be considered by the relevant jurisdictional CVO on a risk-assessed case-by-case basis.

## 6.4 Recommended movement controls

### 6.4.1 Live susceptible animals

#### All species

For animals being transported, compliance with all jurisdictional legislation and the *Australian animal welfare standards: land transport of livestock*<sup>19</sup> is required. This includes ensuring that the animals are fit to load.<sup>20</sup>

#### Live horses and donkeys

Quarantine and movement controls for AHS will apply to all equids, including horses, donkeys and zoo equids (eg zebras). To prevent spread of AHS virus, declared areas (RAs and CAs) will be established with appropriate movement controls on all live equids.

The movement of live equids from high-risk areas (where there is evidence of virus circulation in vectors) is generally not permitted. Movements of live equids into an RA should be minimised, and usually only for slaughter, to limit the number of susceptible animals within the RA.

All movements of live equids to destinations out of an RA are prohibited. The only allowed movements within the RA would be for equids going either to slaughter or, following a risk assessment, to another at-risk premises (ARP), primarily for welfare reasons.

Table 6.1 shows recommended movement controls for live equids.

**Table 6.1 Recommended movement controls for live equids**

To→ From ↓	RA	CA	OA
RA	Prohibited	Prohibited	Prohibited
CA	Prohibited, except for slaughter	Prohibited, except under SpP1	Prohibited
OA	Prohibited, except for slaughter	Prohibited	Allowed under normal jurisdictional and interstate movement requirements

RA = restricted area; CA = control area; OA = outside area; SpP = special permit

#### SpP1 conditions:

- No evidence of clinical disease in animals being moved or on the premises of origin.
- Destination has been advised and agreed.
- If vaccination is being used in the response, animals are fully vaccinated, and 40 days have elapsed since last vaccination.
- All animals moving are individually identified and specified on the permit, for traceability and other purposes.

<sup>19</sup> [www.animalwelfarestandards.net.au/land-transport](http://www.animalwelfarestandards.net.au/land-transport)

<sup>20</sup> Guidelines on whether animals are fit to load are produced by Meat & Livestock Australia (MLA) and are available through the MLA website: <https://publications.mla.com.au>.

- The permit accompanies the livestock during movement, and the person responsible for the livestock retains a copy of the permit, consistent with the legal requirements of the jurisdiction.
- Any animals that develop clinical signs during the [40] days following movement are reported to a government veterinary officer.
- Animals are not permitted to move again for 40 days (ie they must remain at the destination for a minimum of 40 days), except for animals temporarily off-loaded in transit from origin to destination.
- Horses must be treated with insect repellent before transport, transported in vector-protected vehicles and, if temporarily off-loaded, protected from vectors during transit.

## **Dogs**

Evidence of clinical disease and seroconversion to AHS virus has been found in dogs exposed to *Culicoides* vectors in South Africa, in the absence of a history of eating horsemeat. Dogs are dead-end hosts, and movement restrictions will generally not apply. However, movements may be subject to risk assessment.

### **6.4.2 Carcasses**

Carcasses should be disposed of at an approved disposal site (ADS) after ensuring that predation by dogs and dingoes will not occur.

### **6.4.3 Semen and embryos from live susceptible animals**

No scientific information is available on the risk associated with semen or embryos from live susceptible equids. However, the World Organisation for Animal Health *Terrestrial animal health code* recommends measures for the importation of equine semen, embryos and oocytes. Based on bluetongue virus, AHS virus could be preserved in frozen horse semen.

Semen and embryos should not be permitted to be moved out of the RA and the CA, unless the animals from which they are collected have returned a negative serological test for antibodies to AHS virus at least 21 days after collection (EFSA 2021).

### **6.4.4 Meat and meat products**

Contaminated meat and meat products should be disposed of at an ADS after ensuring that predation by dogs and dingoes will not occur.

### **6.4.5 Waste products and effluent**

Waste products and effluent should be disposed of at an ADS after ensuring that predation by dogs and dingoes will not occur and that the potential for *Culicoides* breeding sites is minimised.

#### **6.4.6 Vehicles, including empty livestock transport vehicles and associated equipment**

Vehicles, including livestock vehicles not carrying horses, must be cleaned and treated for vectors before moving

- from the RA to the CA
- from the RA or CA to the OA.

Cleaning and treatment for vectors involves cleaning away manure after each load, then treating the vehicle with an appropriate insecticide that is effective against vectors. For details of appropriate insecticide treatments, refer to the **AUSVETPLAN operational manual *Decontamination***.

#### **6.4.7 Nonsusceptible animals**

For movements of nonsusceptible animals, care must be taken to avoid the concurrent transport of infected vectors (see Section 6.4.6), but no other restrictions should apply.

#### **6.4.8 People**

Movement of people within the RA and the CA will not be subject to restrictions. Care must be taken to avoid transport of infected vectors with any movement of humans or animals.

#### **6.4.9 Specimens**

Specimens should be collected, packed and transported according to Section 2.5.4.

#### **6.4.10 Crops, grains, hay, silage and mixed feeds**

No restrictions apply to the movements of grains, hay, silage and mixed feeds.

The movement of fresh crops from quarantined premises should be subject to risk assessment on a case-by-case basis, taking into consideration the potential presence of infected vectors, the proposed destination and use of the crops, any vector control applied, and any further processing that may occur.

#### **6.4.11 Equipment, including personal items**

Equipment that is contaminated with blood from infected, or potentially infected, animals on infected premises (IPs), dangerous contact premises (DCPs), SPs and TPs should be cleaned before leaving the premises, or disposed of in a biosecure manner (eg through normal biohazard waste management). Although transmission of AHS virus by fomites is not usual, cleaning (or disposing of) such contaminated equipment minimises the likelihood of potential iatrogenic transmission.

#### **6.4.12 Sales, shows and other events**

All sales, shows, race meetings and other events (eg gymkhanas) in the RA involving the congregation of horses and donkeys are prohibited. The conduct of these events in the CA will be under permit and subject to risk assessment on a case-by-case basis.

#### **6.4.13 Stock routes and rights of way**

The use by horses and donkeys of stock routes and rights of way in the RA is prohibited. The use by horses and donkeys of stock routes and rights of way in the CA will be under permit and subject to risk assessment on a case-by-case basis.

#### **6.4.14 Animal movements for emergency (including welfare) reasons**

Movement of AHS virus-infected equids will generally not be permitted even for emergency treatment. The preference is for veterinarians to treat susceptible animals at the property. Transport of AHS virus-infected animals is not recommended because it may exacerbate their clinical condition (C Weyer, South African Equine Health and Protocols, pers comm, 2020).

If a susceptible noninfected animal has to be transported for emergency veterinary treatment, the animal should be treated with an insect repellent before being moved. The destination premises must be risk assessed and, if required, appropriate measures to protect the animal from vectors must be put in place.

Other emergency animal welfare movements (eg as a result of lack of food or water) should be assessed and have permits issued on a case-by-case basis.

## 7 Surveillance and proof of freedom

### 7.1 Surveillance

Evidence of an effective surveillance program is required to demonstrate country or zone freedom from African horse sickness (AHS) virus infection. An effective surveillance program should include clinical, serological and vector surveillance in accordance with Articles 12.1.11–12.1.13 of the World Organisation for Animal Health (WOAH) *Terrestrial animal health code* and the criteria for WOA official recognition of a country's AHS disease status. Surveillance deals not only with the clinical signs caused by AHS virus, but also with evidence of AHS virus infection in the absence of clinical signs and vector activity.

The ability to differentiate infected from vaccinated animals (DIVA) is desirable when vaccination is used. This may or may not be possible, depending on the type of vaccine available for use. DIVA-compliant recombinant vaccines are under development, but currently available attenuated ('live') vaccines are not DIVA-compliant.

#### 7.1.1 Specific considerations

The surveillance strategy should be appropriate for the prevailing epidemiological situation, and include captive, wild and feral equid populations.

Both agent detection and serological surveillance can be used. Blood should be taken from a statistically valid sample of equines and tested for antibodies to AHS virus. Surveillance should include species that rarely display clinical signs, such as donkeys. Samples collected for other purposes may be used for AHS virus surveillance, provided that survey design is epidemiologically sound, as described in Article 12.1.13 of the WOA Terrestrial Code.

Sentinel animals may be used for targeted surveillance to detect new infections or changes in distribution of AHS virus. If used, sentinel animals should be placed to maximise the chance of detecting AHS virus activity.

Where practical, all acute horse deaths within the restricted area (RA) should be reported and investigated to establish a diagnosis or confirm the cause of death. Knackeries could be targeted for surveillance.

#### 7.1.2 Premises surveillance

##### Surveillance on suspect premises

Any suspect cases of clinical disease in equids must be investigated to establish the distribution of infection. Polymerase chain reaction (PCR) screening for viral RNA should be attempted from suitable cases.

##### Surveillance on premises with epidemiological links to the outbreak

Equids should be examined for clinical signs of infection. Identification of virus or viral RNA should be attempted from suitable cases.

## Vector surveillance

Vector monitoring should be undertaken in conjunction with virus monitoring, as described in Article 12.1.13 of the WOAH Terrestrial Code.

The aim of vector surveillance is to accurately identify known competent AHS virus vectors, and define high-, medium- and low-risk areas, as well as vector seasonality. Accurately identifying vector species is important because Australia has endemic *Culicoides* species.

The National Arbovirus Monitoring Program monitors selected economically significant arboviruses and their insect vectors in Australia, including *C. brevitarsis* (AHA 2020). This species is closely related to the known AHS vector *C. imicola*, and the two share temperature requirements for survival (Guichard et al 2014).

Vector surveillance should use sound sampling techniques and traps operated at times of peak *Culicoides* activity (dusk to dawn) near equids (see Appendix 3, and the **AUSVETPLAN resource document *Understanding and responding to Culicoides***).

## 7.2 Proof of freedom

To regain proof-of-freedom status, Australia would need to demonstrate regulatory measures for the early detection, prevention and control of infection with AHS virus in accordance with Articles 12.1.11–12.1.13 of the WOAH Terrestrial Code. Regaining proof of freedom from AHS requires that a country or zone has not reported any case of AHS, or that a surveillance program has demonstrated no evidence of AHS virus in the country or zone for at least 2 years. Routine vaccination against AHS must not have been carried out in the preceding year, and import conditions must be consistent with Chapter 12.1 of the WOAH Terrestrial Code. Proof of freedom may also be recognised if no case of AHS has been reported for at least 40 days, and a surveillance program has demonstrated no evidence of *Culicoides* for at least 2 years in the country or zone. This would not be possible in many parts of Australia, because of the widespread distribution of *Culicoides* species.

# Appendix 1 African horse sickness fact sheet

## Disease and cause

African horse sickness (AHS) is caused by AHS virus, an arbovirus (arthropod-borne virus).

## Species affected

AHS affects all species of the family Equidae (horses, donkeys and relatives) and occasionally canids.

## Distribution

AHS is endemic in all parts of sub-Saharan Africa, with periodic spread further north. It has occurred in Egypt and the Middle East, extending to Pakistan and India in the early 1960s. Spread from north Africa to the Iberian Peninsula has been documented, as has spread from Spain to north Africa. AHS occurred in Thailand and Malaysia in 2020.

## Potential pathways for introduction into Australia

AHS could be introduced into Australia by infected vectors, hosts or vaccines, although these means of entry are strictly controlled.

Windborne movement of vectors infected with serotypes of bluetongue virus does occur from Asian countries to northern Australia, and the occurrence of AHS in Thailand in 2020 increases the potential risk to Australia.

## Key signs

Clinical signs before death include high fever (40–41 °C), progressive severe respiratory distress with paroxysmal coughing and dyspnoea, bilateral foamy nasal discharge and sweating. The case fatality rate is high (up to 95%). Death usually occurs 4–5 days after the onset of depression.

## Spread

Insect vectors provide the natural means of transmission of AHS virus.

## Persistence of the virus

AHS virus does not survive outside the host or vector for long, and products (eg meat, hides) and fomites are not a risk for transmitting infection in the equid population.

## Impacts for Australia

Severe social and financial disruption to the Australian horse industry would occur in the event of an outbreak of AHS in Australia.

## Appendix 2 Salvage of equids infected with African horse sickness virus

### Factors for consideration when determining whether to treat an equid infected with AHS virus

#### Welfare of the affected animal

- Can adequate veterinary and supportive care be delivered on-site, without the need for transport to a veterinary facility?
- What is the severity of clinical signs?
- What is the likelihood of recovery with treatment? This may depend on the equid species affected (eg horse vs donkey vs zoo equid) and also on financial considerations – the owner is responsible for veterinary treatment.

#### Conservation value (ie other than financial – in the case of rare or endangered breeds, or some zoo equids)

- Refer to the AUSVETPLAN guidance document Risk-based assessment of disease control options for rare and valuable animals.

#### Vector protection during viraemia

- Is adequate protection against vectors available (or can it be immediately provided) for the duration of viraemia (infective period 40 days)? (See the **AUSVETPLAN resource document *Understanding and responding to Culicoides***.)
- Are potential AHS vectors active at the site (from National Arbovirus Monitoring Program data and vector surveillance)?
- How will the efficacy of vector protection be assessed and monitored?
- What steps will be taken if vector protection is deemed to be inadequate?
- Can multiple infected equids be housed together? If so, what guidelines might be available about the timing of vector protection (eg all horses housed for at least 40 days from the date the last horse joins)?

#### Permanent identification of the animal

- Is the animal microchipped or otherwise identifiable? If not, the animal must be permanently identified on recovery.

#### Qualitative risk of onward transmission (low/moderate/high)

- Considerations include vector protection, vector activity in the area and likelihood of compliance with isolation procedures.

#### Plan for identification and management of animals post-recovery

- What diagnostic testing plan will be used to confirm that the animal is free from viraemia?
- What measures will be required to ensure permanent identification and traceability of animals that will be antibody-positive in the absence of vaccination? Is DIVA (differentiating infected from vaccinated animals) capacity available?
- What are the future international transport and trade implications of having recovered animals in the population?

### **Public interest in salvage of rare and valuable animals**

See Section 2.1 of the AUSVETPLAN guidance document *Risk-based assessment of disease control options for rare and valuable animals*.

## Appendix 3 Vector monitoring and protection of equids from vectors

For further information, refer to the **AUSVETPLAN resource document *Understanding and responding to Culicoides***.

### Monitoring

Vector monitoring to identify the distribution and relative abundance of vectors present should be one of the first steps in a response to a vector-borne disease.

At the national level, facilities for monitoring are limited, so the resources need to be deployed to achieve maximum effect. Advice must be taken from specialists in this area.

Vector trapping can be supported by serological testing of equids (especially donkeys) to check for antibody responses to African horse sickness (AHS) virus. Presence of antibody to AHS virus in resident equids will indicate the presence of competent vectors in the area.

Siting of traps should be done with epidemiological input and in consultation with members of the National Arbovirus Monitoring Program (NAMP).

Suction light traps are the primary monitoring tools for *Culicoides* species (Venter et al 2009). The reference device recommended by the World Organisation for Animal Health is the Onderstepoort Veterinary Institute (OVI) trap. The black light of the trap attracts primarily female flying midges in search of a blood meal, and traps them in a preserving solution to allow morphological identification. The traps should be set to run all night next to animal facilities.

Although mosquito traps such as the CDC light trap can be used to collect *Culicoides* specimens, they generally do not collect directly into liquid, and individual insects are not well preserved, making identification difficult. Modified CDC traps that collect directly into liquid are commonly used to monitor for biting midges. In Australia, a national trapping network is maintained by NAMP. Most of the trapping is by people in remote areas, generally graziers, cooperating with NAMP. Traps are generally set near cattle and often distant from 240 V power, and so need to be portable, battery operated and easy to use. Modified CDC traps using LED lights and running on disposable D cell batteries have been the most effective trap under Australian conditions (Bishop et al 2006) because they meet all these requirements. These traps are recommended because of their proven effectiveness and because they provide a better comparison with the enormous amount of background trapping data generated by NAMP (G Bellis, Australian Government, pers comm, 2020).

Two alternative methods of collecting that do not rely on artificial attractants are truck trapping and use of animal bait – this includes direct collection of insects from hosts. A truck trap is most effective where evening and night temperatures are low enough to reduce insect activity before it is dark enough for light traps to become attractive. Direct aspiration or sweep netting of insects from hosts is also independent of ambient light levels and has the additional advantage of providing some indication of the species that are biting hosts in the area. Both of these methods are highly sensitive to time of day; many midge species have peak activity for only a short window of 30 minutes around sunset and dawn. When temperatures drop seasonally, this window may move, with midges taking advantage of the warmer temperatures before sunset or after dawn.

Maps with appropriate detail will be required to plot the distribution of traps and equine hosts.

The limiting factor in any monitoring program is the availability of staff with taxonomic expertise to identify the collections. Identifications can be confirmed using polymerase chain reaction technology

for some *Culicoides* species, but this method is impractical for sorting collections with large numbers of specimens.

If collections are to be processed for virus isolation, insects will need to be collected live for immediate processing, or held in suitable storage, such as liquid nitrogen (Dyce et al 1972). Collections for population analysis and identification should be stored in at least 70% ethanol, preferably a higher concentration.

### **Protection of equids from *Culicoides* vectors**

Use of a combination of measures will be necessary to effectively protect animals from attack by *Culicoides* midges:

- House animals in vector-protected housing, especially from 2 hours before sunset until 2 hours after sunrise (note that this will not protect horses from midges that are active during the daytime) – for example, through use of
  - stables
  - insecticide-treated midge mesh (appropriately sized for reducing midge entry) to cover all openings, including doors; mesh reduces airflow, so fans or air-conditioners may be required to regulate temperature.
- Apply DEET insect repellants to animals according to manufacturers' recommendations.
- Eliminate potential breeding sites around animal housing or where livestock are kept by
  - repairing leaks around taps and water troughs
  - draining wet areas
  - removing or covering manure.
- Place traps around and within housing to monitor the effectiveness of protection measures.

Protection of infected animals from vectors (eg if treatment is to be attempted) requires complete exclusion of vectors. Requirements include:

- no unscreened gaps in the walls or ceiling (preferably solid construction to prevent damage that could create openings)
- all openings covered by insecticide-treated 80% shade cloth or midge mesh (or other material with small openings to prevent midge entry); mesh must be re-treated [every 14 days (depending on product used)]
- double-mesh-covered door entry and exit
- positive-pressure ventilation or air-conditioning, if possible
- filters covering all air inlets and drains to prevent vector entry
- use of automatic insecticide dispensers within the facility
- adequate drainage to prevent pooling of water around the facility
- regular removal of organic waste (manure).

# Glossary

## Manual-specific AUSVETPLAN terms

Zoo equids	Exotic equids, such as zebras and Przewalski's horses, kept in zoos.
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## Standard AUSVETPLAN terms

Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hoofs, bones, fertiliser).
Animal Health Committee	A committee whose members are the chief veterinary officers of the Commonwealth, states and territories, along with representatives from the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP) and the Australian Government Department of Agriculture, Fisheries and Forestry. There are also observers from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries. The committee provides advice to the National Biosecurity Committee on animal health matters, focusing on technical issues and regulatory policy. <i>See also</i> National Biosecurity Committee
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved disposal site	A premises that has zero susceptible livestock and has been approved as a disposal site for animal carcasses, or potentially contaminated animal products, wastes or things.
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility that maintains increased biosecurity standards. Such a facility could have animals or animal products introduced from lower-risk premises under a permit for processing to an approved standard.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. <i>See also</i> Chief veterinary officer
AUSVETPLAN	<i>Australian Veterinary Emergency Plan</i> . Nationally agreed resources that guide decision making in the response to emergency animal diseases (EADs). It outlines Australia's preferred approach to responding to EADs of national significance, and supports efficient, effective and coherent responses to these diseases.
Carcase	The body of an animal slaughtered for food.
Carcass	The body of an animal that died in the field.

Case fatality rate	The proportion of infected animals that die of the disease among all animals diagnosed with the disease at the time.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. <i>See also</i> Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with WOAH guidelines, based on applied biosecurity measures and surveillance, to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. <i>See also</i> Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory chief veterinary officers, representatives of CSIRO-ACDP and the relevant industries, and the Australian Chief Veterinary Officer as chair.
Containment zone	WOAH defines a 'containment zone' as an infected zone within a previously free country or zone, which includes all suspected or confirmed cases that are epidemiologically linked and where movement control, biosecurity and sanitary measures are applied to prevent the spread of, and to eradicate, the infection or infestation.
Control area (CA)	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Cost-sharing arrangements	Arrangements agreed between governments (national and state/territory) and livestock industries for sharing the costs of emergency animal disease responses. <i>See also</i> Compensation, Emergency Animal Disease Response Agreement
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery or milk processing plant (or other such facility) that, after investigation and based on a risk assessment, is considered to contain a susceptible animal(s) not showing clinical signs, but considered highly likely to contain an infected animal(s) and/or contaminated animal products, wastes or things that present an unacceptable risk to the response if the risk is not addressed, and that therefore requires action to address the risk.
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility that, based on a risk assessment, appears highly likely to have

	received infected animals, or contaminated animal products, wastes or things, and that requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. There are two types of declared areas: restricted area and control area.
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
Disinsection	The destruction of insect pests, usually with a chemical agent.
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. <i>See also</i> Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. <i>See also</i> Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. <i>See also</i> Emergency animal disease, Exotic animal disease
Enterprise	<i>See</i> Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen-antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. <i>See also</i> Veterinary investigation

Epidemiology	The study of disease in populations and of factors that determine its occurrence.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. <i>See also</i> Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	<i>See</i> Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed or electronic version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> Special permit
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of a pathogen into an animal and the first clinical signs of the disease.
Index case	The first case of the disease to be diagnosed in a disease outbreak. <i>See also</i> Index property
Index property	The property on which the index case is found. <i>See also</i> Index case
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease is present, or there is a reasonable suspicion that either is present, and that the relevant chief veterinary officer or their delegate has declared to be an infected premises.
Local control centre	An emergency operations centre responsible for the command and control of field operations in a defined area.
Monitoring	Routine collection of data for assessing the health status of a population or the level of contamination of a site for remediation purposes. <i>See also</i> Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National Biosecurity Committee	A committee that was formally established under the Intergovernmental Agreement on Biosecurity (IGAB). The IGAB was signed on 13 January 2012, and signatories include all states and territories except Tasmania. The committee provides advice to the

	Agriculture Senior Officials Committee and the Agriculture Ministers' Forum on national biosecurity issues, and on the IGAB.
National Management Group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture, Fisheries and Forestry as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	<i>See</i> Wild animals
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Polymerase chain reaction (PCR)	A method of amplifying and analysing DNA sequences that can be used to detect the presence of viral DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, suspect premises, trace premises, dangerous contact premises or dangerous contact processing facility.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Proof of freedom	Reaching a point following an outbreak and post-outbreak surveillance when freedom from the disease can be claimed with a reasonable level of statistical confidence.
Qualifiers	
- assessed negative	Assessed negative (AN) is a qualifier that may be applied to ARPs, PORs, SPs, TPs, DCPs or DCPFs. The qualifier may be applied following surveillance, epidemiological investigation, and/or laboratory assessment/diagnostic testing and indicates that the premises is assessed as negative at the time of classification.
- sentinels on site	Sentinels on site (SN) is a qualifier that may be applied to IPs and DCPs to indicate that sentinel animals are present on the premises as part of response activities (ie before it can be assessed as an RP).
- vaccinated	The vaccinated (VN) qualifier can be applied in a number of different ways. At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against the emergency animal disease in question. However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used to track a range of criteria and parameters.

Quarantine	Legally enforceable requirement that prevents or minimises spread of pests and disease agents by controlling the movement of animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures, and is subject to the procedures and restrictions appropriate to the area in which it is located.
Restricted area (RA)	A relatively small legally declared area around infected premises and dangerous contact premises that is subject to disease controls, including intense surveillance and movement controls.
Risk enterprise	A defined livestock or related enterprise that is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges and garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. <i>See also</i> Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	The appearance in the blood serum of antibodies (as determined by a serology test) following vaccination or natural exposure to a disease agent.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Slaughter	The humane killing of an animal for meat for human consumption.
Special permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version or electronic of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. <i>See also</i> Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular

	AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
State coordination centre	The emergency operations centre that directs the disease control operations to be undertaken in a state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease.
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. or An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises (SP)	Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s).
Swill	Also known as 'prohibited pig feed', means material of mammalian origin, or any substance that has come in contact with this material, but does not include: (i) milk, milk products or milk byproducts either of Australian provenance or legally imported for stockfeed use into Australia (ii) material containing flesh, bones, blood, offal or mammal carcasses that is treated by an approved process <sup>1</sup> (iii) a carcass or part of a domestic pig, born and raised on the property on which the pig or pigs that are administered the part are held, that is administered for therapeutic purposes in accordance with the written instructions of a veterinary practitioner (iv) material used under an individual and defined-period permit issued by a jurisdiction for the purposes of research or baiting. <sup>1</sup> In terms of (ii), approved processes are: 1. rendering in accordance with the Australian Standard for the Hygienic Rendering of Animal Products 2. under jurisdictional permit, cooking processes subject to compliance verification that ensure that a core temperature of at least 100 °C for a minimum of 30 minutes, or equivalent, has been reached 3. treatment of cooking oil, which has been used for cooking in Australia, in accordance with the National Standard for Recycling of Used Cooking Fats and Oils intended for Animal Feeds 4. under jurisdictional permit, any other nationally agreed process approved by AHC for which an acceptable risk

	<p>assessment has been undertaken and that is subject to compliance verification.</p> <p>The national definition is a minimum standard. Some jurisdictions have additional conditions for swill feeding that pig producers in those jurisdictions must comply with, over and above the requirements of the national definition.</p>
Swill feeding	<p>Also known as ‘feeding prohibited pig feed’, it includes:</p> <ul style="list-style-type: none"> <li>• feeding, or allowing or directing another person to feed, prohibited pig feed to a pig</li> <li>• allowing a pig to have access to prohibited pig feed</li> <li>• the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept</li> <li>• supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig.</li> </ul> <p>This definition was endorsed by the Agriculture Ministers’ Council through AGMIN OOS 04/2014.</p>
Trace premises (TP)	<p>Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to the disease agent, or contains contaminated animal products, wastes or things, and that requires investigation(s).</p>
Tracing	<p>The process of locating animals, people or other items that may be implicated in the spread of disease, so that appropriate action can be taken.</p>
Transmission area	<p>An area, not legally declared, that is used for vector-borne diseases for epidemiological purposes, recognising that vectors are not confined by property boundaries. It includes IPs and, where possible, SPs, TPs, DCPs and DCPFs. A transmission area is subject to an increased level of surveillance.</p>
Unknown status premises (UP)	<p>A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.</p>
Vaccination	<p>Inoculation of individuals with a vaccine to provide active immunity.</p>
Vaccine	<p>A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products or a synthetic substitute, which is treated to act as an antigen without inducing the disease.</p>
– adjuvanted	<p>A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).</p>
– attenuated	<p>A vaccine prepared from infective or ‘live’ microbes that are less pathogenic but retain their ability to induce protective immunity.</p>
– gene deleted	<p>An attenuated or inactivated vaccine in which genes for non-essential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.</p>

- inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
- recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
- native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
- feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
- exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
WOAH Terrestrial Code	WOAH <i>Terrestrial animal health code</i> . Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: <a href="https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access">https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access</a> .
WOAH Terrestrial Manual	WOAH <i>Manual of diagnostic tests and vaccines for terrestrial animals</i> . Describes standards for laboratory diagnostic tests, and the production and control of biological products (principally vaccines). The current edition is published on the internet at: <a href="https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access">https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access</a> .
Wool	Sheep wool.
Zero susceptible species premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with WOAH guidelines, based on geopolitical and/or physical boundaries and surveillance, to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

# Abbreviations

## Disease-specific abbreviations

Abbreviation	Full title
AHS	African horse sickness

## Standard AUSVETPLAN abbreviations

Abbreviation	Full title
ACDP	Australian Centre for Disease Preparedness
AN	assessed negative
ARP	at-risk premises
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DCPF	dangerous contact processing facility
EAD	emergency animal disease
EADRA	Emergency Animal Disease Response Agreement
EADRP	Emergency Animal Disease Response Plan
EDTA	ethylenediaminetetraacetic acid (anticoagulant for whole blood)
ELISA	enzyme-linked immunosorbent assay
GP	general permit
IETS	International Embryo Technology Society
IP	infected premises
LCC	local control centre
NMG	National Management Group
OA	outside area
WOAH	World Organisation for Animal Health (formerly OIE)
PCR	polymerase chain reaction
POR	premises of relevance

<b>Abbreviation</b>	<b>Full title</b>
RA	restricted area
RP	resolved premises
SCC	state coordination centre
SP	suspect premises
SpP	special permit
TP	trace premises
UP	unknown status premises
ZP	zero susceptible stock premises

## References

- AHA (Animal Health Australia) (2020). *Maintaining access to arbovirus sensitive markets*, AHA, Canberra, <https://animalhealthaustralia.com.au/maintaining-access-to-arbovirus-sensitive-markets/>
- Alexander KA, Kat PW, House J, House C, O'Brien SJ, Laurenson MK, McNutt JW & Osburn BI (1995). African horse sickness and African carnivores. *Veterinary Microbiology* 47:133–140.
- Baker T, Carpenter S, Gubbins S, Newton R, Giovanni LI, Wood J & Harrup LE (2015). Can insecticide-treated netting provide protection for equids from *Culicoides* biting midges in the United Kingdom? *Parasites and Vectors* 8:604.
- Barnard BJH, Bengis R, Keet D & Dekker EH (1994). Epidemiology of African horsesickness: duration of viraemia in zebra (*Equus burchelli*). *Onderstepoort Journal of Veterinary Research* 61:391–393.
- Barnard BJ, Bengis RG, Keet DF & Dekker EH (1995). Epidemiology of African horse sickness: antibodies in free-living elephants (*Loxodonta africans*) and their response to experimental infection. *Onderstepoort Journal of Veterinary Research* 62(4):271–275.
- Baylis M, Mellor PS & Meiswinkel R (1999). Horse sickness and ENSO in South Africa. *Nature* 397:574.
- Binepal VS, Wariru BN, Davies FG, Soi R & Olubayo R (1992). An attempt to define the host range for African horse sickness virus (Orbivirus, Reoviridae) in east Africa, by a serological survey in some Equidae, Camelidae, Loxodontidae and Carnivore. *Veterinary Microbiology* 31(1):19–23.
- Bishop AL, Spohr LJ & Barchia M (2004). Effects of altitude, distance and waves of movement on the dispersal in Australia of the arbovirus vector, *Culicoides brevitarsis* Kieffer (Diptera: Ceratopogonidae). *Preventive Veterinary Medicine* 65:135–145.
- Bishop AL, Bellis GA, McKenzie HJ, Spohr LJ, Worrall RJ, Harris AM & Melville L (2006). Light trapping of biting midges *Culicoides* spp. (Diptera: Ceratopogonidae) with green light-emitting diodes. *Australian Journal of Entomology* 45(3):202–205.
- Carpenter S, Mellor PS, Fall AG, Garros C & Venter GJ (2017). African horse sickness virus: history, transmission, and current status. *Annual Review of Entomology* 62:343–358.
- Clift SJ & Penrith M-L (2010). Tissue and cell tropism of African horse sickness virus demonstrated by immunoperoxidase labelling in natural and experimental infection in horses in South Africa. *Veterinary Pathology* 47(4):690–697.
- Coetzer J & Guthrie A (2004). African horse sickness. In: Coetzer J & Tustin R (eds), *Infectious diseases of livestock*, 2nd edn, Oxford University Press, Cape Town, 1231–1246.
- Demissie GH (2013). Seroepidemiological study of African horse sickness in southern Ethiopia. *Open Science Repository Veterinary Medicine*, online:e70081919.
- Dennis SJ, Meyers AE, Hitzeroth II & Rybicki EP (2019). African horse sickness: a review of current understanding and vaccine development. *Viruses* 11(9):844.
- de Waal T, Liebenberg D, Venter G, Meinie C & van Hamburg H (2016). Detection of African horse sickness virus in *Culicoides imicola* pools using RT-qPCR. *Journal of Vector Ecology* 41(1):179–185.
- Dyce A, Standfast HA & Kay BG (1972). Collection and preparation of biting midges (Fam. Ceratopogonidae) and other small Diptera for virus isolation. *Journal of the Australian Entomological Society* 11:91–96.

Eagles D, Melville L, Weir R, David S, Bellis G, Zalucki MP, Walker PJ & Durr PA (2014). Long-distance aerial dispersal modelling of *Culicoides* biting midges: case studies of incursions into Australia. *BMC Veterinary Research* 10:135.

EFSA (European Food Safety Authority) (2021). Scientific opinion on the assessment of the control measures of the category A diseases of animal health law: African horse sickness. *EFSA Journal* 19(2):6403.

EFSA AHAW Panel (European Food Safety Authority Panel on Animal Health and Welfare) (2017). *Characterisation of African horse sickness (AHS) for scientific opinion on vector-borne diseases*, <https://efsa.maps.arcgis.com/apps/MapJournal/index.html?appid=df1fa0739f144112957d2557f9e60a58>.

Elbers ARW, Koenraadt CJ & Meiswinkel R (2015). Mosquitoes and *Culicoides* biting midges: vector range and the influence of climate change. *Revue Scientifique et Technique* 34(1):123–137.

Fall M, Diarra M, Fall AG, Balenghien T, Seck MT, Bouyer J, Garros C, Gimonneau G, Allène X, Mall I, Delécolle JC, Rakotoarivony I, Bakhoun MT, Dusom AM, Ndao M, Konaté L, Faye O & Baldet T (2015). *Culicoides* (Diptera: Ceratopogonidae) midges, the vectors of African horse sickness virus: a host/vector contact study in the Niayes area of Senegal. *Parasites and Vectors* 8:39.

Fischer-Tenhagen C, Hamblin C, Quandt S & Frölich K (2000). Serosurvey for selected infectious disease agents in free-ranging black and white rhinoceros in Africa. *Journal of Wildlife Diseases* 36(2):316–323.

Gichure M, Kitala P, Kihurani D, Mande J & Munene N (2020). Sero-prevalence and risk factors of African horse sickness among donkeys in a highland area of Kenya. *Journal of Veterinary Medicine and Animal Health* 12(3):125–131.

Grewar JD, Weyer CT, Guthrie AJ, Koen P, Davey S, Quan M, Visser D, Russouw E & Buhrmann G (2013). The 2011 outbreak of African horse sickness in the African horse sickness controlled area in South Africa. *Journal of the South African Veterinary Association* 84(1):a973.

Guichard S, Guis H, Tran A, Garros C, Balenghien T & Kriticos DJ (2014). Worldwide niche and future potential distribution of *Culicoides imicola*, a major vector of bluetongue and African horse sickness viruses. *PLoS One* 9(11):e112491.

Harrup LE, Miranda MA & Carpenter S (2016). Advances in control techniques for *Culicoides* and future prospects. *Veterinaria Italiana* 52(3–4):247–264.

Herd Health (2017). *Persistence of disease agents in carcasses and animal products*, version 3, Herd Health Pty Ltd, Maffra, Victoria.

Howell PG (1960). The 1960 epizootic of African horse sickness in the Middle East and SW Asia. *Journal of the South African Veterinary Association* 31:329–334.

King S, Rajko-Nenow P, Ashby M, Frost L, Carpenter S & Batten C (2020). Outbreak of African horse sickness in Thailand, 2020. *Transboundary and Emerging Diseases* 67:1764–1767.

Lord C, Woolhouse M & Mellor P (1997). Simulation studies of vaccination strategies in African horse sickness. *Vaccine* 15(5):519–524.

Lubroth (1988). African horsesickness and the epizootic in Spain 1987. *Equine Practice* 10(2):26–33.

MacDiarmid SC (1991). *The importation into New Zealand of meat and meat products: a review of the risks to animal health*, New Zealand Ministry of Agriculture and Fisheries, 71–72.

- McIntosh BM (1955). Horsesickness antibodies in the sera of dogs in enzootic areas. *Journal of the South African Veterinary Association* 26(4):269–272.
- McIntosh BM (1958). Immunological types of horse sickness virus and their significance in immunization. *Onderstepoort Journal of Veterinary Research* 27:465–539.
- Meiswinkel R (1989). Afrotropical *Culicoides*: a redescription of *C. (Avaritia) imicola* Kieffer, 1913 (Diptera: Ceratopogonidae) with description of the closely allied *C. (A) Bolitinos* sp. nov. reared from the dung of the African buffalo, blue wildebeest and cattle in South Africa. *Onderstepoort Journal of Veterinary Research* 56:23–39.
- Meiswinkel R, Baylis M & Labuschagne K (2000). Stabling and the protection of horses from *Culicoides bolitinos* (Diptera: Ceratopogonidae), a recently identified vector of African horse sickness. *Bulletin of Entomological Research* 90:509–515.
- Mellor PS & Boorman J (1995). The transmission and geographical spread of African horse sickness and bluetongue viruses. *Annals of Tropical Medicine and Parasitology* 89(1):1–15.
- Mellor PS & Hamblin C (2004). African horse sickness. *Veterinary Research* 35(4):445–466.
- Mellor PS, Boorman J & Baylis M (2000). *Culicoides* biting midges: their role as arbovirus vectors. *Annual Review of Entomology* 45:307–340.
- Murchie AK, Thompson GM, Clawson S, Brown A, Gordon AW & Jess S (2019). Field evaluation of deltamethrin and ivermectin applications to cattle on *Culicoides* host-alighting, blood-feeding, and emergence. *Viruses* 11(8):731.
- Murray MD (1987). Akabane epizootics in New South Wales: evidence for long-distance dispersal of the biting midge *Culicoides brevitarsis*. *Australian Veterinary Journal* 64(10):305–308.
- O'Dell N, Arnot L, Janisch CE & Steyl JCA (2018). Clinical presentation and pathology of suspected vector transmitted African horse sickness in South African domestic dogs from 2006 to 2017. *Veterinary Record* 182(25):715.
- OIE (World Organisation for Animal Health) (2019). *Manual of diagnostic tests and vaccines for terrestrial animals*, OIE, Paris, <https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access/>.
- OIE (World Organisation for Animal Health) (2020a). Technical disease card: African horse sickness, OIE, Paris, <https://www.woah.org/en/document/oie-technical-disease-card-african-horse-disease/>.
- OIE (World Organisation for Animal Health) (2020b). *African horse sickness: OIE guidelines on preparedness and implementation of emergency vaccination in the Asian region*, OIE, Paris, [https://rr-asia.woah.org/wp-content/uploads/2020/04/ahs\\_guidelines\\_online.pdf](https://rr-asia.woah.org/wp-content/uploads/2020/04/ahs_guidelines_online.pdf).
- OIE (World Organisation for Animal Health) (2021). Infection with African horse sickness virus. In: *Terrestrial animal health code*, OIE, Paris, [https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=chapitre\\_ahs.htm](https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=chapitre_ahs.htm).
- Oura CAL (2018). A possible role for domestic dogs in the spread of African horse sickness virus. *Veterinary Record* 182(25):713–714.

- Oura CAL, Ivens PAS, Bachanek-Bankowska K, Bin-Tarif A, Jallow DB, Sailleau C, Maan S, Mertens PC & Batten CA (2012). African horse sickness in The Gambia: circulation of a live-attenuated vaccine-derived strain. *Epidemiology and Infection* 140(3):462–465.
- Ozawa Y & Nakata G (1965). Experimental transmission of African horse sickness by means of mosquitoes. *American Journal of Veterinary Research* 26:744–748.
- Ozawa Y, Nakata G, Shad-del F & Navai S (1966). Transmission of African horse-sickness by a species of mosquito, *Aedes aegypti* Linnaeus. *American Journal of Veterinary Research* 27:695–697.
- Page PC, Labuschagne K, Nurton JP, Venter GJ & Guthrie AJ (2009). Duration of repellency of N, N-diethyl-3-methylbenzamide, citronella oil and cypermethrin against *Culicoides* species when applied to polyester mesh. *Veterinary Parasitology* 163(1–2):105–109.
- Page PC, Labuschagne K, Venter GJ, Schoeman JP & Guthrie AJ (2014). Field and in vitro insecticidal efficacy of alphacypermethrin-treated high density polyethylene mesh against *Culicoides* biting midges in South Africa. *Veterinary Parasitology* 203(1–2):184–188.
- Reye EJ (1964). *The problems of biting midges (Diptera: Ceratopogonidae) in Queensland*, Entomological Society of Queensland, Brisbane, <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1440-6055.1964.tb00612.x>.
- Riek RF (1953). Studies on allergic dermatitis of the horse. II. Treatment and control. *Australian Veterinary Journal* 29(7):185–187.
- Robin M, Page P, Archer D & Baylis M (2016). African horse sickness: the potential for an outbreak in disease-free regions and current disease control and elimination techniques. *Equine Veterinary Journal* 48:659–669.
- Rodriguez M, Hooghuis H & Castano M (1992). African horse sickness in Spain. *Veterinary Microbiology* 33:129–142.
- Scott Williams Consulting Pty Ltd & Herd Health Pty Ltd (2017). *Persistence of disease agents in carcasses and animal products*, <https://animalhealthaustralia.com.au/ausvetplan>.
- Sellers RF, Pedgley DE & Tucker MR (1977). Possible spread of African horse sickness on the wind. *Journal of Hygiene* 79:279–298.
- Spickler (2015). *African horse sickness*, technical fact sheet, Center for Food Security & Public Health, Iowa State University, [www.cfsph.iastate.edu/DiseaseInfo/factsheets.php](http://www.cfsph.iastate.edu/DiseaseInfo/factsheets.php).
- van Sittert S, Drew TS, Kotze JL & Strydom T (2013). Occurrence of African horse sickness in a domestic dog without apparent ingestion of horse meat. *Journal of the South African Veterinary Association* 84(1):a948.
- Venter GJ, Koekemoer JJ & Paweska JT (2006). Investigations on outbreaks of African horse sickness in the surveillance zone in South Africa. *Revue Scientifique et Technique* 25(3):1097–1109.
- Venter GJ, Labuschagne K, Hermanides KG, Boikanyo SNB, Majatladi DM & Morey L (2009). Comparison of the efficiency of five suction light traps under field conditions in South Africa for the collection of *Culicoides* species. *Veterinary Parasitology* 166:299–307.
- Weyer CT, Grewar JD, Burger P, Rossouw E, Lourens C, Joone C, le Grange M, Coetzee P, Venter E, Martin DP, MacLachlan NJ & Guthrie AJ (2016). African horse sickness caused by genome reassortment and reversion to virulence of live attenuated vaccine viruses 2004–2014. *Emerging Infectious Diseases* 22(12):2087–2096.

Wilson A, Mellor PS, Szmaragd C & Mertens PPC (2009). Adaptive strategies of African horse sickness virus to facilitate vector transmission. *Veterinary Research* 40:16.