AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Response strategy

Equine influenza

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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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 further worked on by experts and relevant text included at a future date.

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DISEASE WATCH HOTLINE: 1800 675 888

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

Edition 1
1991

Edition 2
Version 2.0, 1996 (major update)

Edition 3
Version 3.0, 2007 (major update and inclusion of new cost-sharing arrangements)
Version 3.1, 2011 (major update in response to the review of the 2007 outbreak)

Edition 4
Version 4.0, 2016 (incorporation into the Edition 4 format and generic text)

Edition 5
Version 5.0, 2020 (not a full update, incorporation into the Edition 5 format)

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1 Introduction

1.1 This manual

1.1.1 Purpose

This response strategy outlines the nationally agreed approach for the response to an incident – or suspected incident – of equine influenza (EI) in Australia. It has been developed to guide decision making and so support the implementation of an efficient, effective and coherent response.

1.1.2 Scope

This response strategy covers EI caused by equine influenza virus.

This response strategy provides information about:

- the disease (Section 2)
- the implications for Australia, including potential pathways of introduction, social 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 (Section 5)
- quarantine and movement controls (Section 6)
- surveillance and establishing proof of freedom (Section 7).

The key features of EI are described in the **Equine influenza Fact Sheet** (Appendix 1).

1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak of EI are based on risk assessment. They are informed by the recommendations in the World Organisation for Animal Health (OIE) *Terrestrial animal health code* (Chapter 12.6) and the OIE *Manual of diagnostic tests and vaccines for terrestrial animals* (Chapter 3.5.7). 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[1]
- relevant nationally agreed standard operating procedures (NASOPs).[2] 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 – EADRA[3]), where applicable.

1.3 Training resources

EAD preparedness and response arrangements in Australia

The EAD Foundation Online course[4] provides livestock producers, veterinarians, veterinary students, government personnel and emergency workers with foundation knowledge for further training in EAD preparedness and response in Australia.

[1] www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents
[2] www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/nationally-agreed-standard-operating-procedures
[3] https://animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement
[4] www.animalhealthaustralia.com.au/emergency-animal-disease-training-program

2 Nature of the disease

Equine influenza (EI) is an acute, highly contagious viral disease that can cause rapidly spreading outbreaks of respiratory disease in horses. Other equine species are also susceptible. Australia and New Zealand are the only countries with significant equine industries that are free from EI without vaccination.

2.1 Aetiology

The causal agent of EI is an influenza type A virus of the family Orthomyxoviridae (genus Influenzavirus A), which also includes viruses infecting humans, birds, dogs and pigs. Two distinct antigenic subtypes (H7N7 and H3N8, first isolated in 1956 and 1963, respectively) infect equine species.

Although human influenza viruses are highly unstable antigenically, EI virus subtypes have remained relatively stable, especially H7N7. The H3N8 subtype has undergone periodic antigenic drift and has diverged into two distinct evolutionary lineages, designated 'American-like' and 'European-like' on the basis of their geographic origin (Daly et al 1996). The geographic distinction has recently become less apparent due to the isolation of 'American-like' viruses in Europe, but the two distinct lineages of H3N8 viruses continue to co-circulate independently. The antigenic variability of the H3N8 subtype has considerable significance for vaccine efficacy and is closely monitored.

The H3N8 subtype is more pathogenic than the H7N7 subtype. The H7N7 subtype has rarely been diagnosed as a cause of disease in the past 20 years and may only persist at a very low level in some regions (Ismail et al 1990, Webster 1993, Madic et al 1996).

2.2 Susceptible species

EI viruses infect all species of the family Equidae (horses, donkeys, mules and zebras), but rarely infect other species. For the purposes of this document, any reference to horses refers to all members of the Equidae family.

In the United States in 2004, an influenza A subtype H3N8 virus was isolated from racing greyhounds with severe respiratory disease. Seroconversion to the virus was demonstrated, and experimental inoculation studies confirmed its aetiological role in respiratory disease in dogs. Using genetic sequence analysis and phylogenetic comparisons, the isolate was shown to have evolved from contemporary strains of equine H3N8 viruses (Crawford et al 2005). H3N8 canine influenza is now found throughout the United States (Beeler 2009), but phylogenetic studies suggest that canine and equine lineages of H3N8 influenza have diverged considerably (Payungporn et al 2008).

During the 2007 Australian outbreak, 10 of 40 dogs at four horse stable complexes in and around Sydney had clinical signs consistent with influenza, and 23 dogs had serological evidence of influenza infection. All dogs recovered (Crispe et al 2011).

Experimental infection with equine H3N8 virus has produced mild influenza-like illness and seroconversion in humans (Kasel et al 1965). However, transmission of EI virus to humans under natural conditions of exposure was not reported during numerous outbreaks of EI in horses in the United States (McQueen et al 1966ab, Davenport et al 1967) or in Australia in 2007.

2.2.1 Zoonotic potential

EI does not affect humans.

2.3 World distribution

For the latest information on the distribution of EI, refer to the World Organisation for Animal Health (OIE) World Animal Health Information Database.[5]

2.3.1 Distribution outside Australia

EI is endemic in Europe (except Iceland), North America and South America. Sporadic outbreaks of the disease occur in these regions, and vaccination is practised. Epidemics occur when a significantly different antigenic virus strain emerges or is introduced, or vaccination levels decrease. The most recent such occasion was in the United Kingdom in 2003. EI is also endemic in north Africa and Asia.

In the past 20 years, serious epidemics in South Africa (1986, 2003), India (1987), Hong Kong (1992), Dubai (1995), the Philippines (1997), Japan (2007) and Australia (2007) have been associated with importations of subclinically infected horses by air from endemic areas and inadequate post-arrival quarantine procedures. Outbreaks of EI in dispersed horse populations in South Africa (1986) and India (1987) led to the disease becoming endemic in the short term, but it eventually burned out in both countries in less than 12 months. Blanket vaccination and strict movement controls have been successful in controlling the disease in intensively managed racing populations, such as in Hong Kong, Japan and Singapore.

An outbreak of EI in northeast China in 1989 with high morbidity and mortality revealed a genome dissimilar to known equine viruses, but similar to some of recent avian origin. Infection with an avian influenza virus in horses was suspected, implying susceptibility of horses to some avian H3N8 strains (Guo et al 1992).

Iceland and New Zealand are the only countries with substantial equine populations never to have reported EI.

2.3.2 Occurrence in Australia

Australia had been free from EI until August 2007, when the disease was introduced with imported horses (Kirkland et al 2011, Watson et al 2011). The causative virus, called A/eq/Sydney/07 H3N8 (Watson et al 2011b), was almost identical to viruses causing an outbreak in Japan in August 2007 and in Pennsylvania in late August 2007 (Newton 2008). EI was subsequently eradicated from Australia, with the last known case on 25 December 2007 (DAFF 2008).

[5] www.oie.int/animal-health-in-the-world/the-world-animal-health-information-system/the-oie-data-system

2.4 Epidemiology

2.4.1 Incubation period

The length of the incubation period is reportedly inversely related to the level of exposure to virus (Mumford et al 1990).

Historically, an incubation period of 2–3 days has been observed in susceptible horse populations during severe field epidemics in the United States (Scholtens and Steele 1964, McQueen et al 1966ab).

Based on numerous observations during the 2007 Australian outbreak, the incubation period in naive horses is 1–5 days.

In naive horses, virus excretion may persist for 7–10 days (Hannant and Mumford 1996). Most shedding occurs in the early stages of clinical disease when coughing is most pronounced. In partially immune horses showing no clinical signs or mild clinical signs, virus shedding may still occur.

OIE incubation period

The OIE *Terrestrial Animal Health Code* (2010) describes the longest infective period for EI as 21 days

2.4.2 Persistence of agent and modes of transmission

General properties

EI virus has a lipid envelope and does not survive long outside the host. Influenza viruses are susceptible to halogens, aldehydes, quaternary ammonium compounds, phenolics, alcohols, peroxides and detergents (Prince and Prince 2001). Mechanisms of action, required concentrations, and influences of formulations and organic contaminants are reviewed by Prince and Prince (2001). Influenza viruses are protected in the presence of organic matter, which increases resistance to physical and chemical inactivation. Organic material should be removed so that disinfectants can work optimally (Swayne and Halvorson 2003).

Environment (including windborne spread)

EI virus is inactivated by exposure to ultraviolet light for 30 minutes, by heating at 50 °C for 30 minutes, and by ether and acid (pH 3) treatment. Exposure to sunlight for 15 minutes at 15 °C also inactivates the virus (Yadav et al 1993).

The virus has been demonstrated to persist (Yadav et al 1993) in:

- canal water (pH 6.9) for up to 18 days at 22 °C and 14 days at 37 °C
- tap water (pH 7.0) for 14 days at 4 °C and up to 2 days at 37 °C
- horse blood for 18 hours at 37 °C
- horse urine (pH 8.0) for 5–6 days at 4 °C, 15 °C and 37 °C
- soil under dark storage at 18 °C for 24 hours
- soil under sunlight at 15 °C for 8 hours.

There are varying views regarding the importance of windborne spread in EI transmission (EI Epidemiology Support Group 2009). Windborne spread from premises over distances of up to 8 kilometres was reported anecdotally in South Africa in 1986 (Huntington 1990). Windborne spread was also suspected in a Jamaican outbreak in 1989 when stud farms within a 2-mile (3.2-km) radius of an infected racing complex became infected after an unexpected change in the prevailing winds to the direction of the farms (Dalglish 1992). Local spread over 1–2 km, possibly consistent with windborne aerosol, was described in the 2007 Australian EI outbreak (Davis et al 2009). However, in the Australian outbreak, there were few (if any) cases where alternative transmission routes could be definitely ruled out (EI Epidemiology Support Group 2009).

Live animals

Within premises, transmission of infection occurs principally by droplets from the virus-laden cough. An infected, coughing horse can spread EI virus 35 metres, and possibly further under favourable air and wind drift conditions (Miller 1965). However, as with other influenza viruses (Loosli et al 1943, Hemmes et al 1960, Bean et al 1982), the survival of EI virus in air may be reduced under conditions of high relative humidity.

In fully susceptible populations, infection can spread rapidly between premises and over long distances by the movement of recently infected horses to and from race meetings, studs, shows, events and sales. In the 2007 Australian outbreak before the imposition of the standstill, infected horses were moved from Maitland to Warwick (approximately 800 km) and introduced disease. Subclinical infection in vaccinated, partially immune horses may result in disease spread both within endemic areas and internationally.

No species other than horses are known to play a significant role in the epidemiology of EI in horses. Direct cross-species transmission from horses to dogs has been reported, but there is no evidence of natural transmission of EI virus from dogs to horses.

Direct respiratory spread from EI-infected horses to susceptible hounds in close proximity in shared airspace during road transportation has been proposed as a route of cross-species transmission (Newton et al 2009). Horses experimentally infected with a recent equine H3N8 isolate were also able to infect dogs in close contact (Yamanaka et al 2009). During the 2007 outbreak of EI in Australia, 23 of 40 dogs in close proximity to EI-infected horses seroconverted, and 10 of the 40 had clinical signs indicative of influenza. One dog returned a positive real-time reverse transcription PCR for 3 consecutive days (Crispe et al 2011).

No unique mechanism for interepidemic propagation of EI virus has been discovered. It is likely that virus is maintained in populations by horse-to-horse transmission between partially immune animals that shed virus without showing clinical signs. This is also the mechanism by which influenza persists in human populations.

EI virus does not persist in the recovered horse, and no carrier state is recognised. A 21-day quarantine period after the onset of clinical signs in the last infected horse will prevent further spread. A short-term, asymptomatic shedding state can exist for a few days in partially immune horses that become infected. In these animals, there may be insufficient viral replication to cause clinical disease. These horses excrete fewer virus particles than clinical cases and are not persistent shedders.

Carcasses

No information is available about the persistence of EI virus in horse carcasses. Virus could be expected to be present in the carcasses of animals that die during the viraemic phase of infection.

Mortality in adult horses is low, and those that die usually do so as a result of secondary complications after the viraemic phase has passed. However, virus may be present in the carcasses of young foals, which rarely die acutely as a result of viral pneumonia. The pH of fresh meat (5.8–6.2) will not be low enough to inactivate the virus.

Animal products

Transmission by animal products and byproducts (such as meat, hides and skins) is not an important means of spread unless susceptible horses contact a contaminated environment very soon after the removal of infected horses.

Infected aerosols might be expected to superficially contaminate horse hides, bedding and stable waste, but the fragility of the virus in the presence of ultraviolet light and heat means that persistence for a prolonged period is unlikely.

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

Transmission of EI virus to a foxhound pack associated with ingestion of raw horsemeat has been suspected in the United Kingdom (Daly et al 2008). The hounds were housed near horses and had been fed horsemeat the week before the onset of clinical signs of disease. The means by which racing greyhounds in Florida (Crawford et al 2005) became infected with an equine-like influenza virus is currently unknown, but it may have occurred by ingestion of infected, uncooked horsemeat (Chambers 2006).

Semen and embryos from live susceptible animals

There is no evidence that equine semen or embryos are involved in the transmission of EI. Spread via equine semen or embryos has never been reported during field outbreaks.

People

After the 2007 Australian outbreak, a retrospective cohort study was conducted to investigate the effectiveness of personal biosecurity and hygiene measures undertaken by 11 individuals who were caring for horses at an infected and quarantined facility containing 255 horses, and who exited that facility and had contact with horses on other properties. No cases of EI occurred on other properties that were attributed to movements by people exiting the quarantine facility (Frazer et al 2011). Arthur and Suann (2011) reported on biosecurity precautions at four racetracks in and near Sydney. For at least 4 weeks, the racetracks remained uninfected, but noncompliance with the biosecurity precautions eventually led to infection.

The potential for spread of infection via human nasal secretions from people exposed to infected horses is unknown, but is likely to be insignificant. Spread by this means has never been reported in field outbreaks.

Vehicles, including empty livestock transport vehicles

Contaminated horse-transport vehicles are a major method for spread unless subjected to adequate cleaning and disinfection procedures. These vehicles often carry horses over long distances in an environment conducive to the persistence of EI virus and could spread the disease rapidly.

Equipment, including personal items

Influenza virus may persist on the surface of contaminated equipment, and mechanical transfer of EI virus on people, clothing and equipment is a significant route of virus spread. In the 2007 Australian outbreak, new cases more than 5 km from the nearest known cases were investigated to attempt to ascertain the source of infection. In most cases, the source of infection could not be categorically determined, but in some cases the only feasible possibility was transfer of virus from horse to human to human to horse. This mechanism of spread was not substantiated.

Contaminated horse-transport vehicles, equipment, grooms, veterinary surgeons, trainers and other people who have close contact with horses are all very important means of transferring infection between premises.

The importance of indirect transmission between establishments by people, horse-transport vehicles and contaminated equipment cannot be overstated. Even though the movement of horses may be controlled, limiting the spread of infection in a susceptible horse population will require very careful attention to decontamination procedures by all people moving between premises containing equines.

Influenza viruses can survive on skin, fabrics and the surface of contaminated equipment. In conditions of 35–40% humidity and at a temperature of 28 °C, both influenza A and influenza B viruses have been shown to survive on hard, nonporous surfaces such as stainless steel and plastic for 24–48 hours, but for less than 8–12 hours on cloth and paper. Higher humidity shortened virus survival. Measurable quantities of influenza A virus were transferred from stainless steel surfaces to hands for 24 hours and from paper tissues to hands for up to 15 minutes. Virus survived on hands for up to 5 minutes after transfer from environmental surfaces (Bean et al 1982). Survival of EI virus for at least 12 hours (overnight) in an uncleaned horse-transport vehicle has been reported (Guthrie et al 1999).

EI virus is inactivated within 30 minutes by a range of disinfectants and chemicals containing chloroxylenol (Dettol), phenolics, alcohol, formalin and potassium permanganate. Sodium carbonate is ineffective (Yadav et al 1993).

The surfactant action of soaps and detergents is an effective decontaminant for EI virus because of the susceptibility of the virus's outer lipid envelope. Soap and water, or alcohol-based hand rubs applied for at least 20 seconds are satisfactory for personal disinfection (Grayson et al 2009). Virkon® and quaternary ammonium compounds are suitable for decontaminating surfaces and equipment, and for foot dips. Virkon® is not approved for use on skin and is unsuitable for disinfecting vehicles, as it is corrosive.

Influenza viruses are protected in the presence of organic matter, which increases resistance to physical and chemical inactivation. Where possible, organic material should be removed so that disinfectants can work optimally (Swayne and Halvorson 2003). Phenolic disinfectants can be used in the presence of high concentrations of organic material. Iodophors can also be used, but their activity is reduced under organic load. Citric acid is also an effective decontaminant.

For further information, see the **AUSVETPLAN operational manual *Decontamination***.

Arthropod vectors

Only equine species are involved in virus replication. Disease transmission by passive mechanical vectors such as insects, birds and rodents is highly unlikely. Flies, other insects and birds may become contaminated with EI virus if they are in close contact with infected horses that have nasal discharge and are shedding virus. The duration of virus survival in these circumstances is unknown. Whether insects and birds are then capable of mechanical transmission of a sufficient dose of viable virus to an

appropriate mucosal surface to initiate infection of a susceptible horse remains to be confirmed, but there are no data to support this conclusion in the veterinary literature.

In the Australian 2007 outbreak, there was speculation about local transmission by insects and birds, but it was not substantiated.

2.4.3 Factors influencing transmission

The critical factors influencing the spread of EI infection in horse populations are the immune status of the horse population (see below), the highly infectious nature of the virus and whether effective movement controls are promptly imposed.

Vaccination can reduce the incidence and size of epidemics in endemic areas, but, in the long term, EI infections will continue to occur as a result of the mobility of horses, incomplete vaccination of the population, antigenic drift and short-lived immunity.

In Australia, recently imported horses may have partial resistance as a result of previous exposure or vaccination. In the 2007 Australian outbreak, locally bred horses that had not travelled overseas were completely susceptible, and the infection spread rapidly in and between groups of horses.

Prompt implementation of a movement standstill as soon as the presence of EI is confirmed can minimise the wider dispersal of horses incubating infection. A descriptive analysis of the 2007 Australian epidemic by Cowled et al (2009) indicated that 81% of the Australian land mass that eventually became infected was initially determined by the dispersal of a few infected horses from horse events held several days before EI was first diagnosed. These horses seeded infection into local horse populations, which later led to the development of substantial disease clusters in New South Wales and parts of southeast Queensland, but other Australian states and territories remained unaffected as a result of movement restrictions.

Compared with clusters in rural areas, peri-urban areas appeared to have a higher density of equine premises, longer epidemics, more infected premises and shorter spread distance. However, effective reproduction rates, cumulative incidence and incidence rates were similar.

Emergency vaccination was introduced about 4 weeks into the response. The role that vaccination played in the containment and eradication of EI in Australia is unclear. The New South Wales and Queensland epidemic curves had both peaked before substantial vaccine-induced immunity could have developed in equines on the earliest premises to be vaccinated (Cowled et al 2009). Infected horses shed very large quantities of virus when they cough, and the minimum infectious dose is very low in previously unexposed horses. The size of the exposure dose is important. Experimentally, it has been demonstrated that higher challenge doses shorten the incubation period, increase the duration of virus excretion and produce more severe clinical signs (Mumford et al 1990).

Glass et al (2002) developed a simple stochastic model to capture the features of an outbreak of EI within a closed population of unvaccinated horses. Using field data from epidemics in the United States in 1963, they calculated that the basic reproduction ratio (R_0) for EI in an unvaccinated population was 10.18; that is, an infected horse in a susceptible population within a yard should, on average, infect 10.18 other horses. When vaccination was included in the model, the incidence and size of epidemics within a closed population were dramatically reduced. In more than 80% of model realisations, less than 5% of the vaccinated horse population became infectious. However, in practice, most horse populations are open.

However, in a field population field study conducted over 3 years at a large thoroughbred track in Canada, Morley et al (2000) found that a recent history of vaccination was not associated with

reduction in disease risk. De la Rua-Domenech et al (2000) modelled the spread of EI within a typical yard of horses in the United Kingdom. They found that the timing of vaccination in relation to the racing season and the arrival of new horses (which may have poor immunity and bring virus with them) was a critical factor. Park et al (2003) cited experimental data showing that vaccination reduced the probability of a horse becoming infectious when challenged by a homologous strain from 1.0 to 0.47, on average. Vaccination also increased the mean latent period from 1.75 days to 2.5 days and reduced the mean infectious period from 4.8 days to 2.5 days. Modelling suggests that the risk of infection is significantly increased if the challenge virus is heterologous (Park et al 2004; see also Section 2.7).

Little objective information is available about the influence of environmental factors on the spread of EI. Outdoor extensive management systems, with horses widely dispersed at low concentrations, are thought to be best for preventing outbreaks of respiratory disease (Wilson 1995). Disease in horses at pasture has been reported to be less severe than in horses stabled in a dusty environment (Dalglish 1992). During the 2007 EI outbreak in Australia, horses on pasture also appeared to show relatively mild signs of disease compared with horses that were stabled. This observation may partly reflect the closer inspection and monitoring associated with horses that are stabled (EI Epidemiology Support Group 2009). Windborne spread has been reported anecdotally (see Section 2.4.2).

High stocking density, enclosed housing and airconditioning may have contributed to the high rate of infection observed during an outbreak in an intensively managed vaccinated population in Hong Kong (Powell et al 1995). However, Morley et al (2000) examined barn type as a risk factor during epidemics of EI in Canada over a 3-year period and could find no consistent association.

2.5 Diagnostic criteria

2.5.1 Clinical signs

Animals

In fully susceptible horses, clinical signs of EI are usually easily recognisable. The primary signs are sudden onset of pyrexia (to between 39 °C and 41 °C); a deep, dry, hacking cough; and a watery nasal discharge, which may later become mucopurulent as a result of secondary bacterial infection. Other signs include depression, loss of appetite, laboured breathing, and muscle pain and stiffness. The disease spreads very rapidly to susceptible in-contact horses, with high morbidity (McQueen et al 1966ab, Gerber 1970, Dups et al 2011, Faehrmann et al 2011).

Vaccination reduces the incidence and severity of clinical signs (Powell et al 1995), and the duration of clinical disease (Morley et al 1999). Clinical signs in vaccinated animals, which may still become infected and shed virus, are variable and can be very difficult to discern. There may be little or no coughing or pyrexia. Subclinical infection can occur. Previously healthy adult horses usually recover from uncomplicated EI within 10 days, although coughing may persist for longer.

Death in adult horses is usually a consequence of secondary bacterial infection leading to pleuritis, pneumonia or haemorrhage, or horses debilitated by intercurrent disease or malnutrition. Other sequelae to EI infection include chronic pharyngitis, chronic bronchiolitis and alveolar emphysema, which contribute to heaves, sinusitis and guttural pouch infections (Gerber 1970).

Rarely, young foals (<2 weeks of age) that lack maternal antibody at the time of exposure to EI virus may develop severe and occasionally fatal viral pneumonia (Miller 1965, Axon et al 2008, Patterson-Kane et al 2008).

In the 2007 Australian outbreak, there was considerable variation in the severity of clinical signs. Coughing was inconsistently reported. Pyrexia was a consistent feature, and nasal discharge was common. There were few deaths, mainly neonatal foals with acute bronchointerstitial pneumonia, or associated with stillbirths and dystocias in mares exhausted from paroxysmal coughing (Gilkerson 2011).

Humans

Not applicable.

2.5.2 Pathology

Gross and microscopic lesions are not specific. There may be hyperaemia or inflammation of the mucosa of the upper respiratory tract. Acute lobular pneumonia or bronchopneumonia is usually present in fatal cases.

The virus infects the ciliated epithelial cells of the upper and lower airways, and can cause deciliation of large areas of the respiratory tract within 4–6 days. As a result, the mucociliary clearance mechanism is compromised, and tracheal clearance rates may be reduced for up to 32 days following infection. Bronchitis and bronchiolitis develop, and are sometimes followed by interstitial pneumonia, accompanied by congestion, oedema and neutrophil infiltration (Jones and Maurer 1943, Daly and Mumford 2001). The pathology of bronchointerstitial pneumonia in young foals during the 2007 Australian EI outbreak has been described by Patterson-Kane et al (2008).

Pathogenesis

In general, H3N8 subtype viruses are more pneumotrophic and cause more severe disease than H7N7 viruses. H3N8 viruses have also been associated with myocarditis (Gerber 1970).

2.5.3 Differential diagnosis

In fully susceptible horses, the major clinical features that may assist clinical diagnosis are fever, coughing, nasal discharge, very rapid spread to susceptible in-contact horses and high morbidity. Rapid spread and high morbidity assist the differentiation of EI from other infectious and noninfectious diseases of the upper and lower respiratory tract that cause coughing and/or nasal discharge, with or without fever.

In the 2007 Australian outbreak, clinical signs were relatively mild in most infected horses.

The following diseases should be considered in a differential diagnosis of EI:

- bacterial bronchopneumonia/pleuropneumonia (travel sickness)
- viral bronchopneumonia due to equine herpesviruses 1 and 4, and equine rhinitis A and B viruses
- inflammatory airway disease due to exposure to environmental irritants and aeroallergens
- equine viral arteritis

- parasitic infections, including ascarids and lungworms
- the pulmonary form of African horse sickness
- strangles
- Hendra virus infection.

2.5.4 Laboratory tests

Samples required

Confirmation of diagnosis may be made by detection of virus or virus product from nasopharyngeal swabs or nasal swabs. Serology in live animals can suggest previous infection, but must be interpreted in the context of vaccination history.

Virus titres are highest during the initial 24–48 hours of fever, which is usually the second or third day after infection. This is the best time to sample for detection of virus (Hannant and Mumford 1996).

EI virus does not generally survive well on dry swabs, and samples must immediately be placed into a viral transport medium containing antibiotics and antifungal agents (OIE 2008). However, in the 2007 Australian outbreak, many swabs transported in saline were positive to PCR testing. Transport media such as Stuarts and Amies are not suitable because they do not contain antibiotics or antifungal agents.

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

All samples should be chilled and forwarded with water ice or frozen gel packs. If delays of more than 48 hours are anticipated in transit, samples should be frozen and sent on dry ice. Samples for virus isolation should not be frozen at –20 °C because viability is significantly less than at 4 °C or at colder (dry ice) temperatures. Serum must be removed from clotted blood samples before freezing.

2.5.5 Laboratory diagnosis

Available diagnostic tests

The principal molecular diagnostic tool for early detection of EI is real-time polymerase chain reaction (qPCR), using an assay developed to detect all type A influenza viruses. This assay was developed specifically for avian influenza preparedness, and was transferred to all Australian state and territory veterinary laboratories (Heine et al 2005, 2007). The influenza A qPCR assay has been validated for detection of EI in nasal swabs (Oakey et al 2007). A distinct qPCR assay specific to equine H3 influenza viruses (Foord et al 2009) is also available.

Characterisation of samples testing positive by qPCR is carried out by sequence analysis, either of the HA and NA genes specifically, or of the complete viral genome.

EI virus can be isolated from nasal swabs by culturing processed samples in specific pathogen-free (SPF) embryonated chicken eggs or Madin Darby canine kidney (MDCK) cells (OIE 2019). Virus growth is indicated by haemagglutination tests, and the haemagglutinin and neuraminidase type is determined by specific antisera and molecular tools.

Virus isolation can also be attempted using appropriate cell cultures for the differential diagnosis of other equine respiratory viruses. It is also essential to isolate the virus for surveillance of antigenic drift and to aid vaccine selection. CSIRO-ACDP can perform genome sequencing for this purpose.

Serological diagnosis is carried out by screening with a blocking ELISA and characterisation of positives by haemagglutination inhibition (HI) tests using antigen of the appropriate haemagglutinin type.

The performance of the ELISA for EI under field conditions was again evaluated after the 2007 Australian outbreak. The sensitivity and specificity of the test were found to be 0.992 and 0.967, respectively (Sergeant et al 2009).

Comparison of diagnostic tests

qPCR assays are the most sensitive tests available for detecting the virus, and are available in LEADDR laboratories. The test can detect viral nucleic acid for some time after viable virus is present, and results must be interpreted accordingly.

Serology is useful for retrospective confirmation of infection, but requires demonstration of a rising titre in serial blood samples. It may be complicated by the presence of vaccine-induced antibody unless vaccines that allow differentiation of infected and vaccinated horses have been used, and paired sera should be tested in parallel to ensure validity of titre comparison.

Virus isolation is a specific method of diagnosis, but its sensitivity depends on the timing and quality of sample collection. It can take a number of days to complete, and suitable 9–11-day-old SPF embryonated eggs or permissive cell lines must be available. Serology (paired sera) and virus isolation are therefore not useful for rapid diagnosis at the onset of an outbreak. Propagation of exotic agents is conducted only at CSIRO-ACDP.

CSIRO-ACDP tests

The testing method used by CSIRO-ACDP is shown in Figure 2.1. Further details of tests currently available at CSIRO-ACDP are shown in Table 2.1.

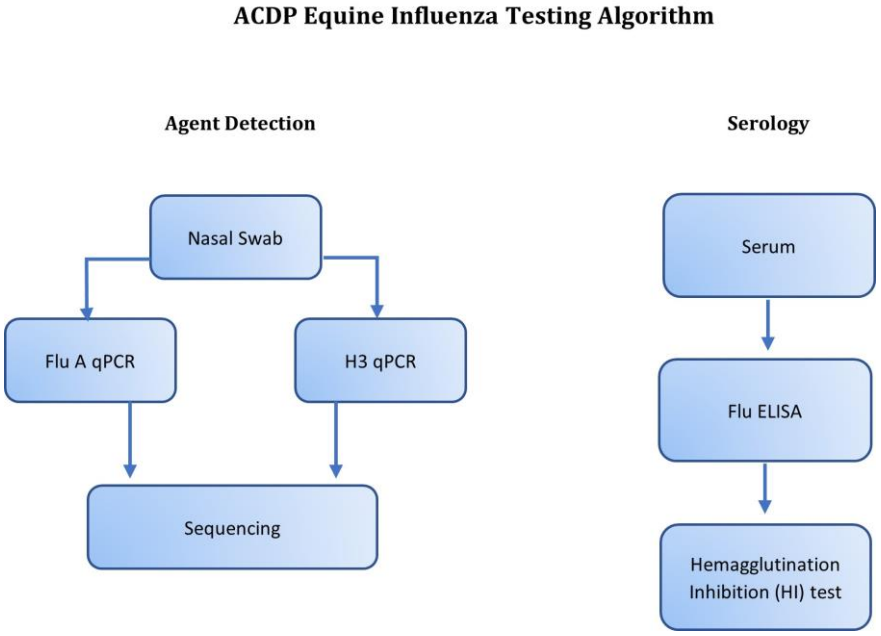

Figure 2.1 The current approach to diagnostic testing at CSIRO-ACDP

Table 2.1 Laboratory tests currently available at CSIRO-ACDP for the diagnosis of equine influenza

Test	Specimen required	Test detects	Time taken to obtain result
Agent detection			
Influenza type A qPCR	Nasal swabs or cultured virus	Viral RNA	4-5 hours
H3 influenza qPCR	Nasal swabs or cultured virus	Viral RNA	4-5 hours
Agent characterisation			
Sequencing	Nasal swabs or cultured virus	Viral genome	2 days
Virus isolation	Nasal swabs in virus transport medium	Virus	5–10 days
Immunoassays	Nasal swabs or cultured virus	H and N subtypes	1 day
Serology			
ELISA	Serum	Group-reactive antibody	1 day

Test	Specimen required	Test detects	Time taken to obtain result
Hemagglutination inhibition	Serum	Serotype-specific antibody	1 day

ELISA = enzyme-linked immunosorbent assay; PCR = polymerase chain reaction; qPCR = real-time PCR
Source: Information provided by CSIRO-ACDP, 2020 (refer to CSIRO-ACDP for most up-to-date information)

2.6 Resistance and immunity

Innate immunity

The role of innate immunity in protecting horses from EI infection is not clear. Horses of any age are susceptible. Foals can acquire maternal antibodies, which may persist for 3–6 months, from immune dams via colostrum.

Acquired immunity

Protection from EI can be acquired by horses through natural infection or vaccination. Natural infection stimulates locally produced mucosal antibody in the respiratory tract and cell-mediated immunity, in addition to serum antibody. There is no cross-protection between antibodies of the H7N7 and H3N8 subtypes.

Active immunity stimulated by natural infection differs from that induced by inactivated vaccines. Infection-induced immunity is not dependent only on the maintenance level of circulating antibody, and protection from EI may persist for at least a year despite a lack of detectable serum antibody, suggesting that cell-mediated immunity has a key role in overall protection. However, previously infected ponies excreted virus for 4–6 days in the absence of clinical signs when rechallenged 16 weeks later (Hannant et al 1988).

The competitive ELISA (c-ELISA) assay can differentiate between increases in antibody levels due to vaccination and increases due to infection (see Section 2.5.5).

2.7 Vaccination

Potent EI vaccines containing virus strains epidemiologically similar to an outbreak strain can limit the magnitude and duration of virus shedding, decrease the severity of clinical disease and reduce the aerosol spread of virus by coughing horses. However, if the outbreak strain is heterologous to vaccine strains, challenge of vaccinated horses with suboptimal immunity can produce subclinically infected horses.

The degree of protection induced by vaccination against infection and disease is closely related to the level of circulating antibody to the haemagglutinin glycoprotein as measured by single radial haemolysis (SRH), a test not available in Australia. Field studies during EI outbreaks in vaccinated populations have shown that horses are generally resistant to infection when the prechallenge SRH antibody level is ≥140–150 mm^2 (Newton et al 2000).

Immunity after natural infection is more robust and long lasting than that induced by vaccination, as both humoral and cell-mediated immune responses are activated.

Vaccine types

In endemic areas, whole inactivated EI virus vaccines are commonly used and provide protection from clinical disease through a short-lived humoral immune response. Currently, most inactivated vaccine formulations require frequent boosters and do not produce complete protection from infection (sterile immunity). Improved adjuvants and antigenic presentation systems have extended the duration of immunity against disease, but high levels of antibody are still required for protection against field infection.

Newer vaccine strategies attempt to mimic the immunity induced by natural infection (Paillot et al 2006). Modern vaccines using DNA plasmids, live attenuated influenza virus (such as temperature-sensitive or cold-adapted influenza virus) or poxvirus vectors coding for influenza virus proteins have been developed, and some are available commercially (Paillot et al 2006).

A cold-adapted, temperature-sensitive, modified live vaccine,[6] administered by the intranasal route as a spray, is registered for use in horses in the United States (Chambers et al 2001, Townsend et al 2001). The local and systemic immune response to this vaccine better mimics immunity induced by wild-type virus (compared with inactivated vaccines) by stimulating production of mucosal antibody in the respiratory tract and a cell-mediated immune response. The immunity generated lasts longer and provides better cross-protection to heterologous virus challenge than that induced by inactivated vaccines. However, this vaccine does not provide complete resistance to infection; levels of serum antibody cannot be used to monitor response to vaccination; and it does not offer the potential to differentiate infected from vaccinated animals (DIVA).

Use of modified or attenuated live influenza virus vaccines raises concerns because of the potential for reassortment of influenza virus with a co-circulating wild-type virus, and subsequent loss of attenuation or emergence of a new, highly pathogenic influenza virus (Paillot et al 2006). The cold-adapted EI vaccine virus described above is believed to be stably attenuated and stably temperature sensitive, and highly unlikely to revert to virulence in the field (Chambers et al 2001). Live influenza vaccine viruses can spread spontaneously to unvaccinated animals (Chambers et al 2001). After vaccination with the cold-adapted EI vaccine, virus was detected in nasal secretions from ponies for up to 7 days postvaccination (Lunn et al 2001).

A recombinant canarypox-vectored EI vaccine[7] is also commercially available. Challenge studies have demonstrated that recombinant EI vaccines are highly effective in conferring clinical protection from EI and significantly reduce virus excretion when compared with unvaccinated controls (Edlund Toulemonde et al 2005, Minke et al 2007a). Unlike conventional inactivated vaccines, the recombinant vaccine also has the advantage that it is able to stimulate active immunity in young foals in the presence of maternally derived immunity against EI (Minke et al 2007b).

Another advantage is that combined c-ELISA and HI testing enables the differentiation of immunity derived from vaccination with a recombinant vaccine from that induced by natural infection (DAFF 2008).

Recombinant vaccines may not induce sterile immunity. In a study by Bryant et al (2010), ponies were challenged experimentally with A/equine/Sydney/07 only 2 weeks after the second vaccination in a primary course of two doses of ProteqFlu™ recombinant vaccine administered 5 weeks apart. Four out of five vaccinated ponies shed live virus for 1–2 days after infection, and two of the ponies excreted

[6] FluAvert™ I.N. Vaccine, Heska Corporation (www.heska.com)

[7] ProteqFlu™, Merial (which was used during the 2007 EI outbreak in Australia) contained two recombinant canarypox viruses expressing the haemagglutinin of A/equine/Kentucky/94 (American lineage, H3N8) and A/equine/Newmarket/2/93 (Eurasian lineage, H3N8) (http://us.merial.com). Merial has since updated ProteqFlu™ vaccine to include the virus strain A/eq/Ohio/03 (American lineage, H3N8), as recommended by the OIE

a peak titre of 1.5 $\log_{10}$-EID50/mLEID50 refers to 50% egg infective dose (ie the dose at which 50% of eggs are infected)[8] on day 2 as determined by egg titration.

Canarypox recombinants do not replicate in mammalian cells, so that dissemination in the environment is not a consideration.

Vaccination schedules

Manufacturers generally recommend a primary vaccination course of two doses, 3–6 weeks apart, with subsequent boosters at 6–12-month intervals. Significant immunity is not present until 7–14 days after the second dose of the primary course. However, in the 2007 Australian outbreak, there were anecdotal reports from veterinarians and owners that less severe clinical signs were seen in horses exposed to EI virus as early as 3–5 days after a first vaccination with a recombinant canarypox-vectored vaccine (EI Epidemiology Support Group 2009).

More frequent booster administration is recommended in high-risk situations, as this schedule may not maintain protective levels of antibody (OIE 2008). Boosters are needed at least every 3–4 months to maintain adequate protection from infection and at least every 6 months to maintain protection from disease. A longer period between primary injections of an inactivated vaccine produces higher antibody levels in the long term (Newton 2005).

During the 2007 outbreak in Australia, a recombinant canarypox-vectored vaccine was registered for emergency use to assist with eradication. The same vaccine was also widely used during the 2003 outbreak in South Africa (Guthrie 2006). An accelerated, 'off-label' vaccination schedule was used in South Africa in 2003 and in some Australian jurisdictions in 2007. An interval of 2 weeks, rather than 4–6 weeks, between the first and second doses of vaccine was used to produce maximum immunity in the shortest time. Retrospective analysis of serum samples collected from horses in a noninfected jurisdiction during the 2007 Australian outbreak found that the accelerated regime conferred rapid immunity. The mean SRH antibody levels generated were comparable to previous studies in horses vaccinated at the usual interval of 4–6 weeks (El-Hage et al 2009).

In countries where EI is endemic, the clinical protection of foals can be increased by vaccination of pregnant mares within a few weeks of foaling to increase the titre of protective antibodies in colostrum. The presence of residual maternal antibody in foals can inhibit the induction of active immunity by EI vaccination (Cullinane et al 2001) when inactivated vaccines are used; therefore, it has been recommended that primary courses of inactivated vaccine in foals be delayed until maternal antibody has completely disappeared (ie after 6 months of age).

The recombinant canarypox-vectored vaccine can stimulate active immunity in young foals in the presence of maternally derived immunity against EI (Minke et al 2007b). During the 2007 outbreak of EI in Australia, the manufacturers' recommendation that vaccination of foals commence at 4 months of age was considered to be relevant only to endemic countries, and younger foals were vaccinated during the emergency response (EI Epidemiology Support Group 2009).

Vaccine strains

Vaccine efficacy can be influenced by strain composition, antigenic content, adjuvant, timing of administration and individual response (Minke et al 2004). Vaccine heterogenicity to the challenge strain may contribute to vaccine breakdown (Daly et al 2003; Park et al 2004, 2009). Like all influenza viruses, EI virus is susceptible to antigenic drift. Antigenic drift was suggested as a major contributing factor in an EI outbreak in vaccinated horses in the United Kingdom in 1989 (Binns et al 1993) and in Croatia in 2004 (Barbic et al 2009).

[8] EID50 refers to 50% egg infective dose (ie the dose at which 50% of eggs are infected)

EquiFluNet,[9] the Global Surveillance Network for Equine Influenza, is hosted by the Animal Health Trust (Newmarket, England) and provides current information about recommended vaccine strains. An Expert Surveillance Panel reports to the OIE Biological Standards Commission, and its recommendations on vaccine strains are published annually in the *OIE Bulletin*.

It is probable that any EI incursion will involve the H3N8 subtype. Antigenically and genetically distinct American and European variants of H3N8 subtype are recognised. For further information, see **Appendix 3**.

Vaccination strategies

Currently in Australia, routine vaccination for EI is not permitted except in horses intended for export.

Vaccination could be used prophylactically in an EI-free country before an incursion to raise population immunity to a level that will reduce the effective reproductive ratio of disease, potentially reducing the size and duration of any future epidemic. Major determinants of the effectiveness of prophylactic vaccination before an outbreak are uptake (the proportion of the population vaccinated) and efficacy (the proportion of vaccinated animals that are protected) (Keeling et al 2003).

Ongoing and effective maintenance of a national prophylactic vaccination strategy would be difficult and very costly for the Australian horse industry, in which the national domesticated horse population is estimated to number at least 932 000 (Centre for International Economics 2007). In addition to the ongoing cost of vaccination, horses will continually change location and ownership, and frequent boosters will be needed to maintain immunity. Achieving greater than 70% immunity in Australia's large domesticated horse population would be impossible.

Vaccine efficacy can be compromised by strain composition, antigenic content, adjuvant, timing of administration and individual response (Minke et al 2004). The H3N8 viruses undergo periodic antigenic drift. Any vaccine used prophylactically might prove not to be protective in the event of a future incursion involving a heterologous field strain.

Following the 2007 EI outbreak in Australia, the expected costs of various EI strategies over a 20-year period were modelled. The costs of having minimal quarantine requirements for EI, pre-emptive vaccination and allowing endemicity were approximately 10 times higher than the least expensive control option. The least costly option involved maintaining effective quarantine measures to exclude EI, a pre-arranged vaccine supply agreement that could be triggered in the event of an emergency and attempting eradication in the event of a future incursion, taking into account lessons learned from the 2007 response to minimise social and economic disruption (Beale et al 2009).

Vaccination can be used reactively in conjunction with quarantine and movement control measures after an outbreak is detected.

Strategies for reactive vaccination include (Keeling et al 2003):

- mass reactive vaccination (swamp vaccination) to build up herd immunity
- ring vaccination, in which vaccination is carried out locally in a ring around identified sources of infection to limit further spread of infection by producing an immune buffer
- predictive vaccination, which targets enterprises and populations that could be expected to contribute most to future spatial transmission of infection.

Ring vaccination outwards from an infected premises (IP) is unlikely to be an effective strategy because of the short incubation period of EI, the movement of horses before the outbreak is reported and the vaccination-to-immunity lag. Uninfected, unvaccinated premises will remain highly

[9] www.equiflunet.org.uk

susceptible; this could generate new epidemics, especially if horses are moved illegally within and from the restricted area (RA).

Ring vaccination inwards from the outer boundary of a declared area makes better biological sense. It may allow authorities to 'get ahead' of the outbreak by creating a vaccinated buffer to reduce the risk of spread. Successful use of this strategy requires rapid access to large quantities of vaccine, an efficient vaccine delivery system and knowledge of the location of horses.

Predictive vaccination of high-risk enterprises can significantly increase the effectiveness of ring vaccination by suppressing virus shedding and hence further virus dissemination if a large enterprise subsequently becomes an IP. Modelling of EI outbreaks (see Section 2.4.3) suggests that vaccination can dramatically reduce the size and duration of outbreaks within enterprises. A foot-and-mouth disease model developed by Keeling et al (2003) indicates that, while predictive vaccination may not decrease overall epidemic size (particularly if it is commenced late), it could shorten the eventual duration of an epidemic by truncating the epidemic tail.

Different EI vaccination strategies have been evaluated by modelling based on data from the 2007 Australian outbreak. It was assumed that vaccination would commence 7 days from the onset of a control program. The model indicated that ring vaccination for 1 km around IPs using two doses of a recombinant vaccine with a 2-week interval between doses was the most effective strategy to slow local spread if resources for vaccination were limited. With greater vaccination capacity, a 3-km ring vaccination was the most effective strategy. However, ring vaccination, particularly in close proximity to IPs, was associated with unreported subclinical infections in the population, with these numbers increasing as the vaccination numbers increased. It was concluded that vaccination on its own was unlikely to contain the spread of infection if the ultimate objective of a control program was eradication, and that control of the movement of vaccinated horses would still be required (Garner et al 2010).

Vaccination strategies and schedules may change with the development of more efficacious vaccines. Currently, most vaccine formulations require frequent boosters and do not produce complete resistance to infection (sterile immunity).

See **Appendix 3** for further discussion of EI vaccination.

2.8 Treatment of infected animals

Currently, no specific antiviral treatment is registered for use for treatment of EI. Although expensive, antiviral drugs developed for human use could conceivably be used in the future to prevent disease or to treat particularly valuable horses in the face of an influenza outbreak. In a randomised, placebo-controlled clinical trial in horses, oral treatment with rimantadine hydrochloride was shown to reduce virus shedding and decrease the total time to recovery in a treatment group compared with controls. However, drug-resistant mutant viruses were detected in the treatment group (Rees at al 1997).

Recommendations for treatment of EI involve isolation, resting of affected horses in a dust-free, well-ventilated environment and supportive therapy.

Prompt isolation of clinically affected horses will reduce virus transmission to susceptible horses, potentially decreasing the subsequent severity and incidence of clinical disease in in-contact horses.

At least 30 days of complete rest is recommended after infection, with a longer period being required if the fever extends for more than 4 days. After 30 days of rest, only light exercise is recommended for a further 4 weeks. Rest reduces the opportunity for secondary infection, hastens complete recovery and thereby decreases the output of infective virus (Daly and Mumford 2001).

Supportive treatment is important to minimise complications and includes expectorants, cough suppressants and mucolytics. Antipyretics and nonsteroidal anti-inflammatory drugs may be indicated in stallions or pregnant mares with very high fevers to avoid testicular degeneration in the former or abortion in the latter. Treatment of secondary bacterial infections with antibiotics may be indicated, particularly if fever persists for longer than 4–5 days, and is accompanied by increasingly abundant and viscous nasal discharge (Gerber 1970). Hyperimmune serum collected from recently recovered (>14 days since recovery) adult horses may be a useful therapy for young foals (Miller 1965).

3 Implications for Australia

3.1 Potential pathways of introduction

Equine influenza (EI) entered Australia in 2007 via a quarantine breakdown. An official inquiry concluded that *'the most likely explanation remains that the virus escaped from Eastern Creek [quarantine station] on the person, clothing or equipment of a groom, veterinarian, farrier or other person who had contact with an infected horse and who then left the Quarantine Station without cleaning or disinfecting adequately or at all'* (Callinan 2008).

EI could be introduced again by imported live horses if biosecurity procedures are inadequate. Since the 2007 incursion, Australia has improved quarantine requirements for importation of live horses to reduce the risk of introduction of EI virus to a very low level.

Saddlery and equipment imported with horses must remain with the horses in post-arrival quarantine or be subject to risk management measures, such as decontamination.

Introduction of EI by imported genetic material or by biological material, such as horse urine for forensic analysis, poses a negligible risk.

3.2 Social and economic effects

EI is likely to result in few adult horse deaths and should not lead to a significant long-term export ban, whether eradication is successful or not. The major impact of the disease will arise from disruption to the movement of horses for racing, breeding, recreation and tourism. The overall impact will depend to a great extent on the time of the year when particular events normally take place, relative to the time of the outbreak.

Social effects

The 2007 outbreak of EI in Australia caused a significant social impact through the disruption of employment in the racing industry, as well as the nonracing sectors of the horse industry. The thoroughbred racing industry employs an estimated 66 480 people (full-time equivalents) (IER Pty Ltd 2007). Horses are also an important resource for human recreation, tourism and amenity, and are used for many commercial and private purposes by the nonracing sector.

Studies of the social impact of the outbreak on individual horse owners showed major effects during the outbreak, although most people were expected to demonstrate resilience afterwards (Taylor et al 2008ab). Disruption of normal social life, which revolves around weekend horse meetings and contacts with other horse-associated people for many recreational owners, as well as worry about their horses' health if they contracted the disease, were key social factors adding distress to the huge economic impacts caused by the outbreak. These social effects, which were largely secondary to the key planks of the EI eradication campaign — movement standstill, movement controls, zoning, property quarantine and personal biosecurity — are likely to be replicated in any similar response. Public awareness messages must be carefully designed to minimise these negative social effects, where possible, while supporting the intent of the program.

Economic impact

The profound economic effects of an EI incursion and response are clearly demonstrated by the costs of the 2007 outbreak in Australia. Official control costs claimable under national cost-sharing provisions amounted to $97.7 million, while the costs of the Equine Influenza Assistance Package to help the equine industries and their employees cope with loss of income and employment during the response came to $256.6 million. Many recreational horse owners did not qualify for the assistance package, so the true costs and economic impacts were far higher. The losses of general and wagering tax revenues by the Australian and state governments were substantial. It is likely that the true costs of the 2007 outbreak in Australia exceeded $1 billion, taking all these components into account.

3.3 Critical factors for an Australian response

- The Australian horse industry is extremely diverse in structure and function, ranging from racing and thoroughbred stud operations to individual backyard horses, with large numbers of horse owners not belonging to any breed or activity organisation. Individual horses may be of high economic or sentimental value, prompting requests for special treatment.
- Disparate sectors have differing risk appetites and differing priorities, and often find it difficult to achieve consensus. A variety of communication methods will need to be employed.
- The nature of the horse industry will present significant challenges in imposing an effective national standstill.
- The quality of government-held information about numbers of horses, their geographic location at land-parcel level and owner details is poor. Property Identification Codes for premises containing horses are not mandatory in some jurisdictions.
- Many horse enterprises operate on a cash basis with few or no records, making tracing difficult even with full cooperation and making it very easy for traces to be hidden by those who wish to avoid regulatory action.
- Many horses are moved frequently, sometimes over great distances and between jurisdictions. Large gatherings of horses occur regularly.
- The economic viability of many sectors of the horse industry depends on free movement and congregation. The horse industry creates significant employment (including in ancillary industries), and horse-related activities play an important part in the social amenity of many Australians. An outbreak of equine influenza (EI) will have a severe social impact.
- Many horse owners and carers (especially smallholders) are less familiar with government animal health procedures than production animal owners, and have limited knowledge of biosecurity principles and practices, and the need to report unusual illness in animals. Fear of repercussions may deter reporting of disease.
- Feral horse populations are generally in locations distant to owned-horse populations, but there are some opportunities for close contact.

4 Policy and rationale

Equine influenza (EI) is a World Organisation for Animal Health (OIE)–listed disease that spreads rapidly in naive horse populations, and has the potential to cause illness and loss of performance. Rarely, it causes deaths in young foals, and debilitated or old horses. It is important in the international movement of horses.

The disease would result in serious economic loss within the equine industry as a result of the constraints placed on the movements and assembly of horses for an extended but unknown period, disruption to business continuity and wagering revenue, the costs of any vaccination program and high morbidity in a naive population.

4.1 Introduction

4.1.1 Summary of policy

The default policy is to contain and then eradicate EI by:

- an immediate widespread *standstill* on horses
- *quarantine and movement controls* of horses and other potentially contaminated items to minimise spread of infection
- implementation of a risk-based *zoning and compartmentalisation* system as soon as possible to define infected and disease-free areas and premises
- strategic use of a vaccine with the capability to differentiate infected from vaccinated animals (DIVA)
- *decontamination* of facilities, equipment and other items
- an increase in horse enterprise and personal *biosecurity*
- *tracing and surveillance* (based on epidemiological assessment) to determine the source and extent of infection, and subsequently to provide proof of freedom from the disease
- *industry support* to increase understanding of the issues, to facilitate cooperation and to address animal welfare issues
- a large *public awareness campaign* to maximise reporting and detection of infected premises.

Vaccination will be used:

- in a radius of 1–10 km from infected premises or areas to reduce the pool of susceptible horses near infected premises and contain EI infection to declared areas
- predictively in enterprises and populations of horses that could be expected to contribute most to future transmission of disease because of the proportionately larger number of people and other items (eg equipment, feed, vehicles) moving onto and off such properties, potentially from and to other properties holding horses
- preventively, in specific compartments of horse populations, to mitigate consequences in infected and unaffected areas by facilitating horse movement and economic activity
- within larger infected areas to increase the level of herd immunity
- more widely if initial control methods have failed, and the disease has spread beyond the original restricted area and is likely to become endemic in the general equine population.

Successful implementation of this policy will be dependent on total industry cooperation, an appropriate funding mechanism for cost sharing eligible response costs, and compliance with all control and eradication measures.

If EI is considered to be widespread when diagnosed or continues to spread despite the application of the above policy, the policy for long-term containment (and possible eradication) of the disease will be determined following consultation between government and the horse industry. The strategies adopted may include increased biosecurity, long-term compartmentalisation and vaccination.

4.1.2 Case definition

For the purpose of this manual, the **initial case definition** of EI is a high-morbidity, rapidly spreading respiratory disease in a group of horses, with laboratory confirmation by polymerase chain reaction (PCR); there may or may not be a history of risk contact.

Once an initial case has been confirmed, the **response case definition** is a horse with clinical signs consistent with EI, with or without laboratory confirmation.

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 Animal Diseases – CCEAD).

4.1.3 Cost-sharing arrangement

In Australia, EI is included as a Category 4 emergency animal disease in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses (EAD Response Agreement – EADRA).[10] When cost sharing of the eligible response costs of an incident is agreed, Category 4 diseases are those for which costs will be shared 20% by government and 80% by industry.

4.1.4 Criteria for proof of freedom

Demonstrating freedom from disease in areas that had been infected allows the reclassifying of zones to lower risk status and progressive removal of horse movement restrictions in response to the improving disease situation.

Reliable data on horse numbers, their ownership and their location are required to plan and implement a surveillance program to demonstrate freedom from EI.

Surveillance will be staged, with the first stage focusing on demonstrating eradication of EI in isolated disease clusters remote from the major zones of infection. The second stage will concentrate on surveillance to demonstrate eradication of disease from any major infected areas. A third stage may, if appropriate, involve confirmatory surveillance to demonstrate that the disease had not infected feral horse populations.

[10] Information about the EAD Response Agreement can be found at www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement.

Proof of freedom from infection in a declared area can be established by passive and active surveillance to determine the time elapsed since the area's last reported case and the resolution of all declared premises; and active surveillance results from both targeted and random sampling. Further evidence of freedom is provided by continued passive surveillance (investigation with negative results of all suspect clinical cases) in both previously infected and uninfected areas, especially once zones have been reclassified and mixing of horses from different areas occurs.

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

EI has no public health implications.

4.3 Control and eradication policy

The default policy for an outbreak of EI is to contain and eradicate the disease.

Quarantine, movement controls (including an initial widespread standstill and subsequent risk-based zoning or compartmentalisation) and strategic use of vaccination (to limit the rate of spread, increase the level of herd immunity and facilitate business continuity) will be implemented to eradicate EI in the shortest possible time.

This policy will be supported by intensive horse industry liaison across all horse industry sectors, and public awareness programs to maximise reporting of suspect cases by veterinarians and horse owners, gain community cooperation and build confidence in disease control measures.

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.

The key objectives for an epidemiological assessment will be to identify:

- the spatial distribution of infected and free animal populations
- potential vectors involved, including as potential amplifying hosts
- the source of infection
- the prevalence of infection
- pathways of spread and the likely size of the outbreak
- risk factors for the presence of infection and susceptibility to disease (including weather and insect populations).

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 (eg considering spatial distribution of infection). 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 to guide the selection of other appropriate response measures (including the application of movement controls) and assess the progress of disease control measures.

Ongoing epidemiological assessment is important for any EAD response to aid evaluation of the continued effectiveness and value of response measures. Ongoing epidemiological 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 6 for details on declared premises and areas, and 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). A restricted area (RA) and control area (CA) will be declared around the infected premises (see Section 5).

Movement controls

Movement controls are best implemented through the declaration of declared areas and linking permitted movements to each area. 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 a minimal risk.

Section 6.4 provides details on movement controls for live animals, reproductive material (semen and in vivo–derived embryos), animal products and byproducts, waste products and effluent, and other items that might be contaminated.

4.3.3 Tracing and surveillance

Tracing

The first reported case (the index case) may not be the primary case for the outbreak. Trace-back may assist in identifying earlier cases and establishing the route of entry of EI to Australia.

The trace-back and trace-forward periods adopted will take into account the short duration of virus shedding by infected horses (7–10 days) and the fragility of EI virus in the environment (see Section 2.4.2). Tracing periods outlined below may need to be varied during the response according to the strategies being followed.

States will trace live horse movements into their jurisdictions from potentially high-risk locations.

Tracing will also be used to determine movements into and out of infected premises (IPs), dangerous contact premises (DCPs), suspect premises (SPs) and trace premises (TPs) (until resolution of infection status) as follows:

- live horse movements during the 10 days before the first signs of clinical infection
- movements of horse-transport vehicles during the 3 days before the first signs of clinical infection
- movements of horse handlers, veterinary surgeons, farriers, horse dental technicians, branders, chiropractors, artificial insemination technicians, feed suppliers and other relevant service providers during the 3 days preceding the outbreak of the disease
- movements of horse equipment (including saddles, bridles and bits, grooming equipment, riding clothes, stable tools) during the 3 days before the first signs of clinical infection
- movements of clothing and equipment used by veterinarians and other service providers during the 3 days before the first signs of clinical infection
- movements of horse carcasses that may have been used as pet food or disposed of off site during the 3 days before the first signs of clinical infection
- movements of semen and embryos (not a high priority for tracing, apart from tracing of collecting personnel) during the 3 days before the first signs of clinical infection.

Surveillance

Initially, surveillance will be necessary to identify undetected foci of infection and determine the extent of an outbreak. Subsequently, surveillance will provide confidence that the outbreak has been contained.

In the initial stages of an EI outbreak, when reports from veterinarians, and horse owners or carers meet the established initial case definition (see Section 4.1.2), SPs and TPs should be visited by an official veterinarian as soon as possible, assessments made and appropriate diagnostic samples obtained. Antigen detection tests on pyrexic horses should be included, as they are useful for establishing a provisional diagnosis (see Section 2.5.5).

However, following an initial diagnosis of EI in an RA, verbal reports meeting the response case definition (see Section 4.1.2) may be sufficient to classify a premises as an IP within that RA, especially if the premises is close to an existing IP at the height of an epidemic. It is not then critical to identify all properties with infection in an area with established infection within an RA, as this knowledge will have little impact on the response to the epidemic. Scarce resources may be more productively employed to ensure that EI is contained within that RA. Premises that are considered highly likely to contain an infected horse or contaminated things will be classified as DCPs.

Personnel conducting surveillance visits to SPs, DCPs and TPs will adopt sound personal biosecurity procedures. Disposable protective clothing (eg gloves, overalls) must be worn when collecting biological samples from horses and must be replaced between properties.

Surveillance for EI in intensively managed horses can be based on daily observation of clinical signs and twice-daily recording of the rectal temperature of each animal. Monitoring rectal temperature may not be practical for large herds of horses at pasture, but horses should be inspected daily for clinical signs. Depending on the size of the outbreak, resource constraints may prevent daily supervision by government personnel, and it may be necessary to rely on the observations of the owner or person in charge of the premises.

See Section 7 for further details of procedures for surveillance and proof-of-freedom requirements.

4.3.4 Zoning and compartmentalisation for international trade

Where it is not possible to establish and maintain disease freedom for the entire country, establishing and maintaining disease-free subpopulations, through zoning and/or compartmentalisation,[11]may be considered.

In the case of a limited disease outbreak, a containment zone[12] may be established around the areas where the outbreak is occurring, with the purpose of maintaining the disease-free status of the rest of the country outside the containment zone.

All zoning applications would need to be prepared by the Australian Government in conjunction with the relevant jurisdiction(s) and agreed to by the CCEAD. Compartmentalisation applications would require input from the relevant industries. Recognition of both zones and compartments must be negotiated between the Australian Government and individual overseas trading partners. Zoning and compartmentalisation would require considerable resources that could otherwise be used to control an outbreak. Careful consideration will need to be given to prioritising these activities, because the resulting competition for resources could delay the quick eradication of the disease and recognition of disease freedom.

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 or compartmentalisation proposal, regardless of the information provided. Eradication of disease may be achieved before zoning or compartmentalisation applications are finalised.

General guidelines for zoning and compartmentalisation are in Chapter 4.4 of the OIE *Terrestrial animal health code*.

4.3.5 Vaccination

General considerations

Importation of EI vaccines is subject to the issuing of import permit(s) from the Australian Government Department of Agriculture and Water Resources. Supply and use of the vaccine in Australia will require an emergency permit and consent to import from the Australian Pesticides and Veterinary Medicines Authority. Importation, distribution, use and disposal of a vaccine that is a genetically modified organism must also be licensed by the Office of the Gene Technology Regulator, or permitted under an Emergency Dealing Determination by the minister responsible for gene technology, or other relevant and appropriate processes.

Vaccination will be approved by the NMG based on the recommendation of the CCEAD.

[11] With zoning, disease-free subpopulations are defined primarily on a geographical basis. With compartmentalisation, disease-free subpopulations are defined primarily by management practices (such as the biosecurity plan and surveillance practices of enterprises or groups of enterprises).

[12] The OIE 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. The Australian Government Department of Agriculture and Water Resources commissioned a report on what would be required for the establishment of containment zones in Australia. This report is available at www.ausvet.com.au/tools-resources.

Specific considerations

Australia's policy is that strategic vaccination of horses in RAs will commence as soon as a suitable vaccine is available. During the period before vaccine is available, imposition of movement controls, and detection and quarantine of IPs will be used to minimise disease spread.

A suitable vaccine will produce rapid immunity to the strain circulating, minimise virus shedding, and enable differentiation between infected and vaccinated animals (DIVA). Vaccines without DIVA capability will not be used for control and eradication purposes as use of such vaccines will complicate serological surveillance and future proof-of-freedom criteria.

A combination of risk-based vaccination strategies will be used, including:

- ring vaccination around foci of infection to contain infection by producing an immune buffer
- predictive vaccination, targeting high-risk enterprises and dense horse populations that may contribute significantly to future spatial transmission of infection
- blanket vaccination in SPCs or infected areas to increase population immunity and encourage the disease to 'burn out'
- preventive vaccination to facilitate business continuity in high-risk enterprises and SPCs.

Vaccination of horses on IPs will be a low priority, as those animals will rapidly become immune as a result of natural infection. However, any unaffected high-risk enterprises in the immediate vicinity of an IP should be vaccinated as a priority.

In general, the vaccination of horses in CAs is not indicated except under one of the above strategies.

Vaccination will be conducted according to the manufacturers' recommendations, unless there is evidence that an alternative regimen would better meet operational needs.

Vaccination teams will adopt sound personal biosecurity procedures to avoid spreading EI between properties or creating the perception that this has occurred. All vaccinated horses should be permanently identified.

See **Appendix 3** for further discussion of EI vaccination supply, strategies and procedures.

4.3.6 Treatment of infected animals

Supportive treatment of horses, while necessary (see Section 2.8), will do nothing to limit the spread of infection.

4.3.7 Treatment of animal products and byproducts

The carcasses of horses that have died during the acute phase of infection will be contaminated. EI virus may survive in fresh, chilled or frozen horsemeat and offal. Normal cooking processes will inactivate the virus in horsemeat (see Section 2.4.2). Within the RA, horsemeat and offal should be cooked before use as pet food.

4.3.8 Destruction of animals

Stamping out

EI has a short clinical course with low mortality, and there is no long-term carrier state.

Destruction of EI-infected animals is inappropriate and unnecessary.

4.3.9 Disposal of animals, and animal products and byproducts

EI virus does not survive long outside the host and is rapidly inactivated by sunlight (see Section 2.4.2). If appropriate biosecurity measures are followed by drivers and if vehicles are appropriately decontaminated between loads, knackery disposal of EI-infected or suspect carcasses is unlikely to contribute to virus spread.

Burial or burning of dead horses will be impractical in many situations, given the close proximity of human populations. It will therefore be desirable to maintain knackery services for IPs and within the RA and CA.

Bedding, manure and other stable waste from an IP should be stored, burned, buried or composted on the IP until quarantine is lifted. If this is not feasible (eg at large communal training complexes), removal to approved premises for composting or burial will be allowed under a general permit.

4.3.10 Decontamination

EI virus is fragile in the environment. Decontamination of horse-transport vehicles and horse equipment between uses, and personal hygiene will play a critical role in controlling the spread of the virus. For further information on the persistence of the virus and recommended disinfectants, see Section 2.4.2.

All people, equipment and vehicles will be decontaminated after contact with horses from IPs, DCPs, SPs or TPs. During an outbreak, all horse transporters in the CA and outside areas should decontaminate their vehicles between loads of horses.

All horse handlers (including veterinarians, trainers, jockeys, grooms, equine dental technicians, farmers, branders, chiropractors and other horse industry service providers) will need to implement a policy of rigorous personal biosecurity when moving between properties, whether in the RA, in the CA or in a wider area.

Surveillance and vaccination teams must pay particular attention to biosecurity procedures when entering and leaving premises.

Premises such as tie-up stalls at racecourses and communal training complexes that have held animals from IPs, DCPs or SPs in temporary accommodation should be appropriately decontaminated before reuse.

Implementation of these programs by disease control authorities will be challenging. An intensive awareness and communication program will be required to facilitate compliance and cooperation from all sectors of the horse industry.

4.3.11 Wild animal management

To contain EI, it may be necessary to prevent its spread into feral horse populations, although, in the 2007 Australian outbreak, such spread did not occur. In areas where feral horses are in close proximity to domestic horses, the latter should be confined to maintain the separation between these groups (see the **AUSVETPLAN operational manual *Wild Animal Response Strategy***). A separation distance of at least 100 metres is recommended. Domestic horses in close proximity to feral horses may be vaccinated as a precautionary measure. Droving on travelling stock routes near feral horse populations will be allowed only under permit, depending on the location of the stock route.

4.3.12 Vector management

Vector control will not be a response priority.

4.3.13 Public awareness and media

Public awareness programs for all sectors of the horse industry and the wider community will be mounted from the onset of an outbreak to gain cooperation and build confidence in disease control measures. Industry stakeholder liaison groups will be established in the affected jurisdictions from the outset of the response to facilitate dissemination of information, and provide feedback on response policy and operations.

Specialist industry-liaison personnel should be brought into control centres as soon as possible to help frame appropriate operational guidelines for particular industry sectors (eg racing and breeding, pleasure and performance, and horse industry service providers, including private veterinary practitioners, farriers and equine dental technicians) as needed.

Because of the disparate and diverse nature of the horse-owning population, community meetings will be very valuable and should be held as required in specific affected areas to provide feedback on the rationale for, and progress with, the program, and to seek local information to fine tune operations.

The potential for local spread of disease will be reduced by detailed public awareness programs emphasising biosecurity, and/or through the distribution of information packs to horse owners, veterinarians and other horse industry service providers. These guidelines should provide specific information on topics such as equipment and vehicle decontamination, movement requirements, managing visitors, quarantine and isolation, fence security, reporting of suspect cases and specific veterinary issues (eg sampling and handling protocols). It is critical that a wide variety of industry-related organisations and service providers be kept fully and accurately informed. Many individual horse owners in urban and regional areas are not affiliated with any organisation and can only become informed through their informal contacts and through the media.

Briefings to the industry and media will be provided daily from the outset of the response.

Specific features required for the horse industry awareness program include:

- notification of movement controls and reasons for their imposition
- the need for horse owners and their veterinarians to report suspicious cases of respiratory disease immediately so that potentially infected properties can be identified very early, even before it has been possible to complete tracing and epidemiological investigations
- the legal responsibility of people to report suspicion of EI and other notifiable diseases
- recommended biosecurity procedures to minimise the spread of EI

- easily accessible contact points for further information
- emphasis on web- and email-based information dissemination and acquisition, and on hotlines to deal with the likely volume of requests
- special liaison officers, who should be appointed to deal with groups of people quarantined with their horses away from home (eg at showgrounds).

The general public identifies with horses and their welfare, and many people have a keen interest in racing and other equestrian events. Given the zoonotic aspects of recent outbreaks of avian influenza in Asia, there may also be concern that EI could jump species. The public will need to be reassured that public health is not threatened and that EI causes horses only short-term distress, and to be informed of the reasons for cancellation of racing and other horse events.

See the **Biosecurity Incident Public Information Manual** for further details on what should be included in a public awareness campaign.

4.3.14 Other strategies

For some diseases, such as foot-and-mouth disease and equine influenza, the initial response to strong suspicion or confirmation of the disease in any affected jurisdiction will be the immediate declaration of a widespread standstill prohibiting all new live movements of live susceptible animals into, out of or within declared areas unless a specific permit has been issued. Continued movement of susceptible animals that are in transit at the time the standstill is declared may be allowed, depending on the risk presented by the journey.

The standstill will be triggered by the NMG, acting on the advice of the CCEAD, and will be implemented for at least 72 hours. The standstill will become more widespread after CCEAD agreement and advice to the NMG, and will be implemented in each jurisdiction through the relevant state or territory legislation. Any extension or lifting of the standstill will be based on an assessment of risks, the outcomes of initial tracing, surveillance information and the identified epidemiology of the outbreak. Lifting of the standstill may occur at different times in different jurisdictions.

When and if it is confidently established that EI has been introduced only to a defined area of Australia, nationally harmonised risk-based zoning or compartmentalisation will be implemented to focus control efforts more efficiently, reduce the social and economic impact of the outbreak, and allow continuation of horse racing, equestrian events and other horse movements in low-risk areas. Information about zone and compartment boundaries, and the controls applying in the different zones and compartments may be communicated using colour coding.

Zone boundaries will be based, where possible, on natural or artificial features that will restrict spread of infection. For example, the boundaries of zones will be drawn through areas of low horse density associated with natural features precluding horse premises (such as national parks).

Initially, it is better for the zones with the most rigorous movement controls to be larger than considered necessary, to manage the risks of unknown foci of disease and to minimise the need to expand the size of the zone later. The geographical limits of zones can be changed during the course of the outbreak based on surveillance results, with emphasis on reducing the areas subject to restrictions as fast as possible, consistent with risk assessments of the presence or absence of disease. Communications challenges will have to be overcome for each change.

There are no criteria in the OIE Terrestrial Code for the zoning or compartmentalisation of EI for international trade purposes. However, the designation of an enterprise or group of enterprises as a compartment for special purposes (SPC) may allow the maintenance of biosecurity while minimising disruption to normal activities. Application can be made for an enterprise or group of enterprises with

an epidemiologically closed population of horses within a single declared area to enter into an agreement to be classified as an SPC in order to maintain biosecurity while minimising disruption to its normal commercial activities.

Acceptance of a zoning or compartmentalisation policy will need to be negotiated bilaterally with international trading partners, particularly New Zealand. This is likely to take some time and may not be successful.

4.4 Other control and eradication options

The policy options in response to an outbreak of EI are:

- do nothing
- containment, with a view to eventual eradication
- eradication (the default policy described above)
- recognition of endemic status.

Do nothing

A response might not occur in the absence of an agreed government or industry funding mechanism for cost sharing. This option is likely to lead to endemic status.

Containment, with a view to eradication

If EI is considered to be widespread when diagnosed or continues to spread despite the application of the default policy, the policy for long-term containment (and possible eradication) of the disease will be determined following consultation between governments and the horse industry. However, from experience in other countries, this policy is unlikely to succeed.

Eradication

This is the default policy; see Section 4.3.

Recognition of endemic disease

If EI is widespread in multiple jurisdictions when first detected, with little chance of its containment or eradication, government will encourage the implementation of appropriate strategies by the horse industry organisations (at industry cost). The strategies may include improved biosecurity, long-term compartmentalisation and vaccination.

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.[13] 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***.

[13] www.animalhealthaustralia.com.au/what-we-do/emergency-animal-disease/ead-response-agreement

5 Guidelines for classifying declared areas and premises

When an emergency animal disease (EAD) incident 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[14]), 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.[15] A transmission area (TA) may also be defined, if appropriate. 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.

[14] The first case to come to the attention of investigators

[15] 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).

An EAD may involve multiple foci of infection, with several jurisdictions potentially involved. Since disease might be controlled at different rates in different areas, there may be the opportunity to progressively lift restrictions on an area basis. This would involve reclassifying previously declared areas (RAs and CAs), with a staged approach to lifting of movement restrictions. This is a key step in the recovery process and will have positive benefits on the community.

5.1.1 Restricted area (RA)

An RA is a relatively small legally declared area around IPs and DCPs that is subject disease controls, including intense surveillance and movement controls.

An RA will be a relatively small declared area[16] (compared with a CA) drawn with at least 10 km radius around all IPs and DCPs, and including 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 does not need to be circular but 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 boundaries will be modified as new information becomes available, including from an official surveillance program. The actual distance in any one direction will be determined by factors such as terrain, the pattern of livestock movements, livestock concentrations, the weather (including prevailing winds), the distribution and movements of relevant wild (including feral) animals, and known characteristics of the disease agent. In practice, major geographic features and landmarks, such as rivers, mountains, highways and roads, are frequently used to demarcate the boundaries of the RA. Although it would be convenient to declare the RA on the basis of local government areas, this may not be practical, as such areas can be larger than the particular circumstances require.

5.1.2 Control area (CA)

A CA is a legally declared area where the disease controls, including surveillance and movement controls, applied are 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 CA will have a minimum radius of 20 km, encompassing the RA(s). It may be defined according to geography, climate and the distribution of relevant wild (including feral) animals. The boundary will be adjusted as confidence about the extent and distribution of the incident increases.

[16] As defined under relevant jurisdictional legislation

In general, surveillance and movement controls will be less intense in the CA than in the RA, and disease-susceptible animals and their products may be permitted to move under permit within and out of the area.

5.2 Other areas

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

5.3 Declared premises

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

5.3.1 Premises status classifications

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.

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).

Trace premises (TP)

Temporary classification of a premises that contains a 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).

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.

Approved processing facility (APF)

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.

Approved disposal site (ADS)

A premises that has zero susceptible livestock and that has been approved as a disposal site for animal carcasses or potentially contaminated animal products, wastes or things.

At-risk premises (ARP)

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.

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, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.

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.

Unknown status premises (UP)

A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.

Zero susceptible species premises (ZP)

A premises that does not contain any susceptible animals or risk products, wastes or things.

5.3.2 Qualifiers

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

Assessed negative (AN)

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. SPs, TPs, DCPs or DCPFs, once assessed negative, can progress through the SP-AN, TP-AN, DCP-AN or DCPF-AN status to another status. The animals on such premises are subject to the procedures and movement restrictions appropriate to the declared area (RA or CA) in which the premises is located.

This classification is a description to document progress in the response and in the proof-of-freedom phase. The AN qualifier is a temporary status and only valid at the time it is applied. The time that the AN qualifier remains active will depend on the circumstances and will be decided by the jurisdiction.

One day is considered a reasonable guideline. The AN qualifier should also provide a trigger for future surveillance activity to regularly review, and change or confirm, a premises status.

The AN qualifier can also function as a counting tool to provide quantitative evidence of progress, to inform situation reports in control centres during a response. It provides a monitor for very high-priority premises (SPs and TPs) as they undergo investigations and risk assessment, and are reclassified, as well as a measure of surveillance activity overall for ARPs and PORs.

The AN qualifier can be applied in a number of ways, depending on the objectives and processes within control centres. The history of each premises throughout the response is held in the information system; the application of the AN qualifier is determined by the jurisdiction, the response needs and the specific processes to be followed in a local control centre.

Sentinels on site (SN)

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).

The qualifier should not be applied to premises that have been resolved and have been allowed to restock (regardless of the stocking density chosen for initial restocking).

Vaccinated (VN)

The VN qualifier can be applied in a number of different ways.

At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against the EAD in question.

However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used to track a range of criteria and parameters. The details would need to be developed and tailored to meet individual needs of jurisdictions and circumstances.

The AN and VN qualifiers may be used together if surveillance, an epidemiological assessment and/or laboratory assessment/diagnostic testing support the premises being assessed as negative, and susceptible animals on the premises have also been vaccinated against the EAD.

5.3.3 Other disease-specific classifications

Compartment for special purposes

Application can be made for an enterprise or group of enterprises with an epidemiologically closed population of horses within a single declared area to enter into an agreement to be classified as a compartment for special purposes (SPC), to maintain biosecurity while minimising disruption to normal activities. There may be two classes of SPC — infected and free — with the biosecurity measures aimed at preventing the spread of infection out of the compartment (in the case of the former) and into the compartment (in the case of the latter).

Enterprises to be classified as an SPC must meet specific conditions:

- The application must be made by a body that has demonstrated power to enforce compliance with biosecurity measures, documented standard operating procedures and adequate resources to monitor compliance with the measures. Measures will include the ability to implement and operate checkpoints for entry and exit of horses as required; the decontamination of horse-transport vehicles, equipment and personnel; and an approved surveillance program.

- A free SPC must be at least 10 km from any known IP. In the event of an IP being classified closer than 10 km from an existing free SPC, the biosecurity of the compartment will need to be re-evaluated.
- An SPC may include multiple premises with horses — for example, a racecourse, riding complex, agistment farm or trail-riding centre where the horses are housed and train or work on the premises and are managed as a unit.

Within an infected SPC or infected area (IA), all premises containing susceptible animals are considered to be IPs.

An IA may be designated within the RA, with very strict entry and exit conditions for live horses and decontamination requirements, but more relaxed internal movement conditions than the RA. Within the IA, all premises containing susceptible animals are considered to be IPs.

5.4 Resolving premises and reclassifying 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.

An EAD may involve multiple foci of infection, with several jurisdictions potentially involved. Since disease might be controlled at different rates in different areas, there may be the opportunity to progressively lift restrictions on an area basis. This would involve reclassifying previously declared areas (RAs and CAs), with a staged approach to lifting of movement restrictions. This is a key step in the recovery process and will have positive benefits on the community.

5.4.1 Reclassifying 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.
- All tracing and surveillance associated with EAD control has been completed satisfactorily, with no evidence or suspicion of infection in the area.
- A minimum period of 42 days[17] has elapsed since predetermined disease control activities and risk assessment were completed on the last IP or DCP in the area or a risk assessment supports reclassification.
- An approved surveillance program (including the use of sentinel animals, if appropriate) has confirmed no evidence of infection in the RA (see below).

[17] The minimum period uses, or is based on, the disease-specific incubation periods defined by the OIE – two incubation periods is a common guideline.

- For vector-borne diseases, vector monitoring and absence of transmission studies indicate 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 (EADRP). 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 the RA or lift all restrictions. The previous part of the RA would then become part of the CA. Jurisdictions should be able to present documented evidence that the appropriate conditions have been met.

When an RA is lifted and becomes part of the CA, it will have a lower risk status, and the movement restrictions that apply will be consistent with those applying within the CA. Over time, all of the RAs will be reduced and lifted.

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.

After a further period of surveillance and monitoring, and provided that the additional surveillance and monitoring find no evidence of infection, a jurisdiction, in consultation with the CCEAD, could lift the CA. This would result in the lifting of all the remaining regulatory controls associated with the response.

6 Movement controls

6.1 Principles

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

- Containment and eradication of equine influenza (EI) is the highest priority. Therefore, 'normal business movements' are not allowed.
- Live animals pose the greatest risk of disease spread; therefore, their movements from all premises 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 animals 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.
- 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 (NMG).
- 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. Therefore, it is not appropriate to simply prohibit all movement of animals and products. On the other hand, diligence needs to be applied to minimise the risk of further spread of the disease.

Recommended quarantine 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
    - species of animal
    - type of product
    - presence of disease agent on both the originating and destination premises
    - current vector activity, if relevant
    - organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
    - proposed use of the animals or products
    - 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
    - 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. They 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 – NVDs).

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 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 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

When EI is initially suspected or confirmed in a jurisdiction, movement of horses onto and off individual infected premises (IPs), SPs, dangerous contact premises (DCPs) and TPs will be immediately controlled, and appropriate biosecurity measures will be invoked. Movement controls will be maintained until the status of each premises has been clarified or resolved. Movement restrictions will be modified if the area within the RA in which the premises are located is reclassified as an infected compartment (see Section 4.3.2).

6.4.1 Live susceptible animals

A phased approach to movement controls will be implemented. The first two phases will apply when the standstill is in place. The third phase will be just after the standstill has been revoked, and RAs and CAs are being set up. The fourth phase will occur when the authorities are confident that the outbreak has been stabilised.

Where possible, the boundaries of RAs and CAs should take into account the location of compartments. As all horses in a compartment would be of the same health status, a compartment must lie entirely within a single declared area.

Phase 1: Live horses in transit at the time of the declaration of the standstill

Horses undergoing a journey at the time of the declaration of the standstill can proceed without a permit if the journey will be completed within a specified period (eg 4 hours) with no crossing of state boundaries and no contact with horses not of the same consignment during the journey. If this condition cannot be met, the horse will return directly to the premises of origin for that journey.

When a standstill is invoked, a saturation media campaign will be conducted, advising people in charge of horses in transit at the time of declaration of the standstill to follow the above directions. If their situation does not fit one of these scenarios, they should contact their local animal health authorities for directions concerning ongoing movement. Directions may include:

- Return to property of origin; if the horses originate from another jurisdiction, the authority in that jurisdiction should be consulted and involved in the risk assessment.
- If the horses are moving to local or regional properties that can be secured to prevent disease spread, or if the horses are consigned for slaughter at a knackery, they may proceed to the original intended destination.
- Movement to an alternative approved property with no horses or a low density of horses — for example, cattle or sheep property, saleyard, or showgrounds with no other horses in the immediate area.

Phase 2: Movement of live horses while the standstill remains in force

While the standstill remains in force, the movement of horses is prohibited except under a special permit. A permit will be issued only in exceptional circumstances, such as the unavailability of feed or water, the need for emergency veterinary treatment, or the need to escape natural disasters such as fire or flood.

Standard permit conditions for the movement of live horses during the standstill are as follows:

- Receiving premises is of an appropriate biosecurity standard.
- Receiving premises is not allowed to move horses off until standstill is revoked.
- Travel by approved route only.

- Single consignment per load.
- Appropriate decontamination of equipment and vehicles.
- Absence of clinical signs on day of travel.
- Individual horse identification.

The conditions above apply to specific categories of journeys. Other types of journeys will require a risk assessment, taking into account factors relating to the likelihood that the proposed movement may spread disease, and welfare implications. High-risk outcomes, such as movements to areas, premises or property situations where there is a high density or congregation of horses, should be avoided.

Relevant factors to be considered in issuing an emergency permit during the standstill include:

- the probability that the horses are infected and the proposed movement may spread disease; this probability is higher if
    - horses originate from the infected area, region or jurisdiction
    - horses originate from premises with a high density of horses, or commingle with horses of different origins and frequently move between premises for competition purposes
    - there has been a change of horse-transport vehicle or a stopover during the journey
    - the consignment is a mixed load
- welfare implications — for example
    - prolonged transport times and noncompliance with relevant welfare codes
    - retention of horses in temporary holding facilities at racecourses or other event venues for prolonged periods, compromising their welfare
    - horses with acute conditions requiring urgent veterinary attention
    - continued access to feed and water of cattle and sheep on stock routes if horses are involved in droving activities
- regulatory implications (eg road transport legislation)
- biosecurity considerations when it is not practical or possible for horses to return to their place of origin.

Phase 3: Movement of live horses within and between areas after the standstill has been lifted, and RAs and CAs are being set up, but the outbreak is not considered to be under control

Movement out of a designated infected area (IA) or infected compartment for special purposes (SPC) is prohibited.

Movement within a designated IA or SPC is unrestricted.

Table 6.1 shows movements of live horses that are allowed and not allowed during phase 3 control.

Table 6.1 Movement of live horses during phase 3

To→ From ↓	**RA**	**CA**	**Outside the RA and CA**
RA	Prohibited – except: • for urgent veterinary treatment or in case of a welfare emergency - SpP conditions a, g, p, r • for movement into an IA or an infected SPC - GP conditions g, h, p, r • for movement into a free SPC within the RA - GP conditions b, i, j, k, q	Prohibited	Prohibited
CA	Prohibited, except under GP — conditions g, h, p, r	Prohibited, except under GP — conditions g, h, p, r	Prohibited
Outside the RA and CA	Prohibited, except under GP — conditions g, h, p, r	Prohibited, except under GP — conditions g, h, p, r	Allowed (under normal jurisdictional, including inter-state, requirements)

CA = control area; GP = general permit; IA = infected area; RA = restricted area; SPC = compartment for special purposes; SpP = special permit

Phase 4: Movement of live horses within and between areas, when the RAs and CAs are in operation, and the outbreak is considered to be under control

Standard permit conditions for all movements of live horses when RAs and CAs are in operation:

- Receiving premises is of an appropriate biosecurity standard.
- Receiving premises is not allowed to move horses off within 3 days after arrival of horse.
- Single consignment per load.
- Travel by approved route only.
- Appropriate decontamination of equipment and vehicles.
- Absence of clinical signs on day of travel.
- Individual horse identification.

Table 6.2 shows the movements of live horses that are allowed and not allowed during phase 4 control.

Table 6.2 Movement of live horses during phase 4

To→ **From ↓**	**RA**	**CA**	**Outside the RA and CA**
RA	Prohibited, except under SpP — conditions d, e, f, l, m	Prohibited, except under SpP — conditions b, i, j, k, q	Prohibited, except under SpP — conditions n, o
CA	Prohibited, except under GP — condition c	Prohibited, except under GP — conditions n, o	Prohibited, except under GP — conditions n, o
Outside the RA and CA	Prohibited, except under GP — standard conditions apply	Prohibited, except under GP — standard conditions apply	Allowed (under normal jurisdictional, including inter-state, requirements)

CA = control area; GP = general permit; RA = restricted area; SpP = special permit

6.4.2 Other movements

Table 6.3 shows the movement controls that will apply to things other than live horses on IPs, DCPs, SPs or TPs in the event of an EI incident.

Declared premises

Table 6.3 Movement controls for declared premises

Quarantine/movement controls	IP and DCP	SP and TP
Movement out of:		
• susceptible animals	See Section 6.4.1	See Section 6.4.1
• other live animals	Allowed under general permit	As for IP/DCP
• specified products	Equine carcasses can be moved under special permit to knackeries, but must not be used for pet food unless cooked	As for IP/DCP
• equine semen and embryos	Allowed under general permit	As for IP/DCP
• bedding and stable waste	Must be either disposed of on site, or moved under general permit for disposal by an approved method	As for IP/DCP
• horse feed, hay and straw	Allowed under general permit	As for IP/DCP
• crops and grains	No restrictions	As for IP/DCP
• people in contact with horses	Allowed under general permit, with appropriate personal biosecurity	As for IP/DCP
• vehicles and equipment	Horse-transport vehicles, knackery trucks, horse equipment, etc — prohibited except under special permit	As for IP/DCP
Movement in of:		
• susceptible animals	Allowed under general permit, for movement into or within an SPC	As for IP/DCP
• equine semen and embryos	Allowed under general permit	As for IP/DCP
• horse feed, hay and straw	Allowed	As for IP/DCP

Quarantine/movement controls	IP and DCP	SP and TP
• people	Allowed	As for IP/DCP
• vehicles and equipment	Allowed under general permit, with appropriate biosecurity	As for IP/DCP

DCP = dangerous contact premises; IP = infected premises; SP = suspect premises; SPC = compartment for special purpose; TP = trace premises

Declared areas

Table 6.4 shows the movement controls that will apply to things other than live horses in declared areas, but not on an IP, DCP, SP or TP, in the event of an EI incident. For live horses, see Section 6.4.1.

Table 6.4 Movement controls for declared areas

Quarantine/movement control	RA (if declared)	CA (if declared)
Movement of:		
• specified products	Equine carcasses can be moved under special permit to knackeries, but must not be used for pet food unless cooked	Allowed
• equine semen and embryos	Allowed under general permit	As for RA
• other animals	Allowed	As for RA
• people in contact with horses	Allowed under general permit, with appropriate personal biosecurity	As for RA
• vehicles and equipment	Horse-transport vehicles, knackery trucks, horse equipment, etc — prohibited except under special permit	As for RA

CA = control area; RA = restricted area

7 Surveillance and proof of freedom

7.1 Surveillance

7.1.1 Specific considerations

Sampling

Long nasopharyngeal swabs are collected using autoclavable tubing that contains a sterile swab on a soft stainless steel wire guide that is drawn back into the tubing. The tubing is advanced into the nasopharynx via the ventral meatus to the full length of the wire, and the wire guide is then pushed out the end of the tube, allowing the swab to contact the mucosa. After gentle rotation and contact of about 30 seconds, the swab is drawn back into the end of the tube before withdrawal of the tube. Most horses accept the procedure without restraint, but a twitch may be necessary for some animals. The use of nasopharyngeal swabs is recommended if the amount of virus a horse is shedding is likely to be low, such as in vaccinated or previously exposed horses.

If long nasopharyngeal swabs are not readily available, adequate samples can be collected by vigorously swabbing the nasal septum and ventral meatus of both nostrils using conventional short cotton-tipped swabs. These may be superior to nasopharyngeal swabs for field use because of better owner acceptance and commercial availability (Morley et al 1999). Guarded swabs that are used for uterine culture in mares could also be used, but their rigidity means that care has to be taken to avoid epistaxis (bleeding from the nose).

Clotted blood samples of about 10 mL each should be collected from pyrexic horses and from the same horses 2–4 weeks later, or from other convalescent horses.

Disposable gloves should be worn when collecting samples and should be replaced before sampling each horse. Particular care must be taken when collecting samples at the same time as horses are being vaccinated.

In particular, evidence will be collected by:

- absence of characteristic clinical disease in unvaccinated, serologically negative horses in restricted areas (RAs)
- random surveillance in the RAs using real-time polymerase chain reaction (PCR) sufficient to detect infection with a 95% confidence level at a prevalence of 1% on a premises
- targeted surveillance around recent infected premises (IPs), dangerous contact premises (DCPs), and suspect premises (SPs) or trace premises (TPs) using real-time PCR
- serological monitoring of horses by competitive enzyme-linked immunosorbent assay (c-ELISA) in the RA and control area (CA), assuming that only recombinant vaccine has been used so that seropositive animals will have been naturally infected
- negative EI real-time PCR or virus isolation from cases of acute equine respiratory disease occurring within any area.

7.1.2 Premises surveillance

Surveillance strategy during the outbreak

Because of the highly infectious nature of EI, surveillance tasks should be urgently prioritised in the following order:

1. Follow up high-risk traces, particularly live horses from known IPs.

2. Visit all DCPs contiguous with IPs and examine any horses present.

3. Visit SPs and TPs in the RA and CA.

Tests for the rapid detection of viral antigen RNA (eg TaqMan®-based real-time PCR) should be conducted on pyrexic horses. Febrile horses in the early course of clinical disease are more likely to be virus positive. Recovered horses are less likely to return positive results for virus presence. Serum should also be collected for serology.

The short incubation period of EI means that clinical signs are likely to be seen at the first surveillance visit if infection has occurred. If no signs are noted, periodical monitoring of horses should continue for a further 10 days. Ideally, this would be on a daily basis, but resource constraints are likely to dictate the interval between visits. The owner or person in charge of the DCP or SP should be asked to monitor the rectal temperature (if practical) and clinical signs of all horses on the premises between surveillance visits, and to report any abnormalities immediately.

DCPs and TPs can be reclassified as either at-risk premises (ARPs) or premises of relevance (PORs) if no cases of EI are detected during surveillance visits and if 10 days have elapsed between the trace and the last visit, with no evidence of EI detected.

SPs can be reclassified as ARPs or PORs if no cases of EI are detected from samples taken during surveillance visits and if 10 days have elapsed after cessation of suspicious clinical signs in horses.

All properties in the RA on which horses are resident should be visited, if feasible, or contacted at least weekly to ensure that they remain free from disease. The owner or person in charge of the premises should be asked to monitor the rectal temperature (if practical) and clinical signs of all horses between surveillance visits, and to report any abnormalities immediately.

Surveillance in the RA and CA should continue for at least 4 weeks following the onset of clinical signs in the last infected horse in the RA, to provide confidence that virus is no longer circulating. If no further IPs are detected during that period, movement controls can then be lifted.

7.2 Proof of freedom

The World Organisation for Animal Health (OIE) Terrestrial Code states that, if an outbreak of clinical EI occurs in a previously free country, zone or compartment, disease-free status can be regained 12 months after the last clinical case. However, active surveillance for evidence of infection must be carried out during that 12-month period.

An important factor in survey design is the ability to differentiate immunity resulting from natural infection from immunity resulting from vaccination (DIVA test). This ability will depend on use of a suitable vaccine, such as the recombinant vaccine used in the 2007 outbreak, which provides immunity without stimulating a full range of antibodies to EI virus, as well as the availability of c-ELISA or other tests to detect antibodies from natural EI infection, and real-time PCR to detect any virus or viral antigen. Screening using serological tests can be done in areas not known to have been infected, and any horses giving a positive result can be retested using PCR.

Surveillance should take a staged approach. The first stage focuses on eradicating EI in isolated disease clusters that are remote from the major zones of infection. The second stage concentrates on surveillance to demonstrate eradication of disease from the heavily infected areas. The third stage involves confirmatory surveillance to demonstrate that feral horse populations are not infected.

Surveillance for proving disease freedom in previously infected, remote clusters focuses on determining the basic population data and immunity levels (both natural and vaccine induced) within regions, and ensuring that all IPs, SPs, DCPs and TPs have been resolved. In areas with only a few IPs and evidence of little or no spread, a minimum period of 42 days must have elapsed since the last IP was declared (based on 14 days for infection to spread through all susceptible animals on the premises, plus 28 days for all infected animals to become seropositive) before an area can be considered for reclassification. In clusters involving a small number of IPs, serosurveillance can be used on previous IPs to demonstrate that infection has passed (immunity is present). Investigation of neighbouring properties can be conducted using PCR testing to ensure that no lateral spread of infection occurred. In addition, an extensive random survey of horse premises in all areas should be undertaken to ensure a 95% level of confidence that disease would be detected if its prevalence on a premises exceeded 1%.

After all remote clusters have been demonstrated to be free from infection, surveillance should then be focused on zones where infection was widespread. In these areas, all IPs, SPs, DCPs and TPs must be resolved, and at least 42 days must have elapsed since the last IP was declared. More extensive surveillance may be required to provide confidence that eradication has been achieved.

To detect any EI in feral horse populations in the unlikely event of spread from domestic populations, populations of feral horses may need to be sampled.

Following declaration of provisional freedom, passive and targeted surveillance should be put in place and all suspect cases investigated to rule out EI. Removal of movement restrictions as areas are rezoned allows the mixing of formerly infected and naive populations of horses, with the latter acting as sentinels for any residual infection.

Appendix 1

EQUINE INFLUENZA FACT SHEET

Disease and cause

Equine influenza (EI) is caused by an influenza type A virus.

Species affected

EI viruses infect horses, donkeys, mules and zebras.

EI does not affect humans.

Distribution

EI is widely distributed throughout the world, but is not present in Australia.

Potential pathways for introduction into Australia

EI could be introduced again by imported live horses if biosecurity procedures are inadequate.

Key signs

Key signs in horses are sudden onset of fever, a deep, dry, hacking cough, and a watery nasal discharge, which may later become thick as a result of secondary bacterial infection. Other signs include depression, loss of appetite, laboured breathing, and muscle pain and stiffness.

Spread

The EI virus spreads rapidly through horse populations through direct contact, nasal secretions and via the spread of droplets through coughing.

Persistence of the virus

The EI virus has a lipid envelope and does not survive long outside the host, and is very susceptible to inactivation with alcohols and detergents.

Impacts for Australia

EI is likely to result in few adult horse deaths and should not lead to a significant long-term export ban, whether eradication is successful or not. The major impact of the disease will arise from disruption to the movement of horses for racing, breeding, recreation and tourism. The overall impact will depend to a great extent on the time of the year when particular events normally take place, relative to the time of the outbreak.

Appendix 2

PERMIT CONDITIONS

a.	Movement must be directly to a veterinary hospital (for treatment) or to new holding area (for welfare reasons).
b.	Horses have not originated from an IP, DCP, SP or TP.
c.	Horses have not originated from a DCP, SP or TP.
d.	Horses have not originated from an IP,[18]from a DCP or from within 5 km of an IP.
e.	Horses have not originated from an SP or TP except for urgent veterinary attention or a welfare emergency.
f.	For susceptible and vaccinated horses, the premises have had no introduction of horses for 14 days before movement.
g.	There is individual horse identification.
h.	There are no clinical signs of EI on the day of travel.
i.	For susceptible horses, there is an isolation (minimum of 7 days), followed by pre-export quarantine (PEQ)[19](minimum of 14 days) with two rounds of testing with polymerase chain reaction (PCR), and post-arrival quarantine (PAQ) (minimum of 7 days).
j.	For vaccinated horses, there are: • two rounds of testing with PCR, and either • the premises had no introduction of horses for 14 days before movement, with isolation of moving horses for the final 7 days, or • PEQ (minimum of 7 days) and PAQ (minimum of 7 days).
k.	For recovered horses, there must be PEQ (minimum of 3 days) with positive competitive enzyme-linked immunosorbent assay (c-ELISA) and PAQ (minimum of 3 days).
l.	A sample of horses on the premises has been tested to confirm non-IP status (including testing of all moving horses).
m.	For recovered horses,[20]their positive c-ELISA was within 16 weeks before movement.
n.	For susceptible and vaccinated horses, there is an isolation (minimum of 7 days) and two rounds of testing with PCR.
o.	For recovered horses, there is an isolation (minimum of 3 days) with positive c-ELISA.
p.	Travel is by approved route only.
q.	There is a single consignment per load.
r.	There is appropriate decontamination of equipment and vehicles.

[18] Within the RA, IPs may be declared as a single IP or combined into a single IP (or infected compartment), with free movement of horses within the compartment

[19] PEQ and PAQ to be operated on an all-in, all-out basis

[20] A recovered horse is one that was infected by EI virus at least 30 days previously as demonstrated by the presence of a positive c-ELISA

Appendix 3

VACCINATION SUPPLY, STRATEGIES AND PROCEDURES

Vaccine supply

No EI vaccine is manufactured in Australia. Although manufacture is technically feasible, its lead time would be many months. During an epidemic, initial vaccine requirements will have to be imported.

Before any future outbreak of EI, as part of contingency planning, Australia should identify appropriate overseas vaccines and arrange shelf registration permits for their emergency use with the relevant regulatory authorities.

In recent years, the H3N8 subtype has shown significant antigenic drift. The OIE Expert Surveillance Panel on Equine Influenza Vaccine Composition (reporting to the OIE Biological Standards Commission) makes recommendations on vaccine strains.[21] The recommendations of the OIE panel should be monitored and reviewed annually to ensure that EI vaccines approved for import to Australia provide appropriate coverage of field strains causing international outbreaks. Vaccines for EI control and eradication should have the capacity to differentiate infected from vaccinated animals (DIVA).

The PUBCRIS database of the Australian Pesticides and Veterinary Medicines Authority can be searched to find details of products registered in Australia and products for which minor use or emergency use permits are in place.[22]

Comprehensive information about vaccines available internationally and contact details for manufacturers can be found on the EquiFluNet website.[23]

A number of major international companies have subsidiaries or distributors in Australia that could provide a conduit to vaccine access.

Achieving a satisfactory timeframe for emergency importation of suitable vaccine to Australia will require pre-planning, and good coordination between government authorities, vaccine manufacturers and importers. Difficulty may be experience in obtaining sufficient quantities internationally, as stockpiles vary throughout the year, depending on production runs and local demand.

Theoretically, a vaccine bank (onshore or offshore) or a vaccine supply arrangement could ensure that vaccine stocks are quickly available. Potential problems relating to the establishment of a vaccine bank or supply arrangement are that H3N8 EI viruses can drift significantly and that new vaccine technology is rapidly being developed. This leads to a significant risk that, if an outbreak occurs, a vaccine might contain epidemiologically irrelevant strains and be of inferior efficacy to vaccines produced by newer methodology. There would also be difficult and complex issues relating to apportioning the costs associated with development and maintenance of such a strategy.

Local vaccine manufacture is technically feasible, but Australia has limited manufacturing capability. Planning, including importation of vaccine seed or antigen and production information from overseas, would be necessary if a local vaccine were to be available early in an outbreak. Alternatively, an Australian isolate could be developed into a master seed or antigenic product after an outbreak occurs. However, the significant antigenic drift of EI in recent years and the ready international availability of

[21] www.oie.int/en/our-scientific-expertise/specific-information-and-recommendations/equine-influenza
[22] https://portal.apvma.gov.au/pubcris
[23] EquiFluNet, the Global Surveillance Network for Equine Influenza, hosted by the Animal Health Trust, Newmarket, England (www.equiflunet.org.uk)

high-quality vaccines suggest that the need for, and benefit from, local manufacture, particularly in advance of an outbreak, are questionable.

For further information about sourcing emergency animal disease vaccines in Australia, see Tweddle (2009).

Horse identification

Identification of vaccinated animals is important to:

- meet regulatory requirements for emergency use of recombinant vaccine
- ensure an accurate system for determining when booster vaccination is required
- identify subclinical infection in vaccinated horses, particularly if there is a mismatch between the vaccine strains and field strains
- confirm the identity of a horse presented for movement as a vaccinated horse
- facilitate post-eradication serological surveys (that will require differentiation of vaccinated horses from those likely to have been exposed to EI)
- permit ready identification of vaccinated horses to facilitate any future proof-of-freedom surveys
- facilitate business continuity during the recovery phase
- facilitate business continuity if EI is not eradicated and becomes endemic.

Vaccinated horses should be permanently identified using a radio-frequency identification (RFID) device inserted on the near (left) side of the neck, halfway between the poll and wither, and just under the line of the mane, into the nuchal ligament or the fibro-fatty tissue surrounding the nuchal ligament. Horses already identified with an RFID device as part of existing industry registration programs are not re-implanted unless the existing device does not work. Horses with a legible harness-racing brand will be exempted from microchipping. Other important horse identification features, such as brands, and other physical identifying characteristics, such as blazes, should be recorded on a vaccination certificate at the time of vaccination. Accurate records should be kept of the location and identity of all vaccinated horses.

A means of ready access to certification of a horse's vaccination status will be important. Ideally, a vaccination certificate should travel with the horse. Most Australian horses do not have written identification documents, and many are not permanently identified. With the exception of FEI (International Equestrian Federation) passports, existing identity documents do not have spaces for recording vaccination or test results.

All named and unnamed, parentage-verified Australian thoroughbreds are freeze branded. All thoroughbreds born after July 2003 are now also identified by an implanted microchip, which has replaced hard-copy identification certificates. The identity of a thoroughbred can be obtained from the Australian Stud Book website[24] by searching on either microchip number or brand. The Australian Stud Book has an interactive web-based system for recording vaccination status against horse microchip number, which was used during 2007.

All registered standardbred horses are freeze branded with a unique registration number. The identity of a horse can be obtained from the website of Harness Racing Australia by searching on its brand.[25] If necessary, the council could also develop a web-based system for recording vaccination status. During an outbreak, mandatory microchipping of the standardbred horse with legible freeze brands will not be necessary.

[24] www.studbook.org.au
[25] www.harness.org.au

Horse numbers, ownership and location

Reliable data on horse numbers, and the ownership and location of horses will assist planning and implementation of an emergency response vaccination program. A detailed dataset on the distribution, ownership and density of horses does not exist in Australia. During the 2007 EI epidemic in Australia, databases of equine premises were compiled by disease control centres in New South Wales and Queensland from a variety of sources (Cowled et al 2009, EI Epidemiology Support Group 2009), including:

- routine surveys of livestock holdings collected by state veterinary services before the epidemic
- horse industry databases
- equine premises recorded in emergency animal disease information management systems as infected premises, or as part of surveillance and vaccination operations
- entries from online registration systems for horse properties and horse ownership
- equine veterinary practitioners
- information gathered via permit processes for horse movements
- ad hoc sources, such as telephone directories.

Vaccination strategy

Vaccination alone will not control EI during an outbreak. Additional measures, such as effective movement controls and strict biosecurity procedures, will be essential to achieve eradication.

Risk-based vaccination strategies (see Section 4.3.5) will be implemented by infected jurisdictions to contain EI, with the objective of eradication, as part of their Emergency Animal Disease Response Plan. Comprehensive information concerning the implementation of vaccination strategies during the 2007 EI outbreak in Australia can be found in the report from the EI Epidemiology Support Group (2009).

Initially, vaccination in response to an EI outbreak will be undertaken in the face of uncertainty about the likely rate of disease spread, the eventual size of the epidemic, and the closeness of the antigenic match between the circulating virus and available vaccines.

Consideration will need to be given to logistical constraints, such as the likely delay before vaccination can be started, the size of the population to be vaccinated and the number of horses that can be vaccinated per day.

The likely period between ordering a pre-approved vaccine and optimal immunity in vaccinated horses is likely to be at least 7–9 weeks, assuming 1 week for supply of vaccine, 2 weeks to carry out vaccinations if a significant population is to be vaccinated, a 2–4-week intervaccination interval, and 1–2 weeks for effective immunity to develop after the second dose of the primary course. The likely spread of disease during this time should be anticipated when formulating a vaccination strategy. Preventive vaccination in specific compartments of horses to facilitate business continuity (see Section 4.3.5) will be undertaken on a user-pays basis. It must be kept in mind that variations in vaccine-induced immunity may create problems for the recognition of future EI cases outside the restricted area, and that partially immune animals may have subclinical disease and still shed virus.

Distribution and administration of vaccine

During an emergency response to EI in Australia, vaccine use and distribution will be controlled by jurisdictions and facilitated by Animal Health Australia.

End users of vaccine will need to be educated about correct storage and distribution of vaccines to ensure maximum efficacy, and to avoid loss and wastage. Animal Health Australia will develop an agreement with a refrigeration and logistics services company to act as agents to receive imported

vaccine once it has cleared Australian customs and to provide cold-chain facilities for the distribution of the vaccine to distribution points nominated by the chief veterinary officers in each affected jurisdiction.

Distribution points will be required to maintain lockable cold storage that can maintain an appropriate temperature range for storage of the vaccine. Temperature monitors will be required to ensure that vaccine does not freeze. Vaccine will be packed appropriately to ensure cold-chain integrity during transport by private veterinarians. Detailed information on transport requirements will be provided at the time.

Care must be taken that vaccination teams do not spread the disease. Vaccination teams may transmit disease between premises if there are biosecurity breakdowns, particularly if teams are operating in or near infected areas.

During the Australian outbreak in 2007, vaccine was administered by a combination of government-employed veterinarians, veterinarians employed by the racing authorities and private equine practitioners across a wide area, under the conditions of an emergency response. An online training module was developed by Animal Health Australia for registered veterinarians administering the vaccine.

Adverse reactions

There is no evidence that vaccination of horses already incubating influenza is harmful, but vaccination of clinically ill horses is not recommended. Adverse reactions to EI vaccination, including local reactions, lethargy, loss of performance and respiratory problems, were anecdotally reported after mandatory EI vaccination of thoroughbred racehorses was introduced in the United Kingdom in the 1980s. Reports of adverse reactions have decreased with the advent of better adjuvanted vaccines (J Mumford, Animal Health Trust, Newmarket, United Kingdom, pers comm, December 2005). All vaccine manufacturers recommend a period of rest after vaccination to avoid exercise-induced adverse reactions, but the scientific basis for this is unclear.

During the 2007 EI outbreak in Australia, reported adverse reactions to a recombinant (canarypox-vectored) EI vaccine were very infrequent compared with the number of horses vaccinated. Transient swelling at the site of injection was the most commonly observed minor adverse event. Generally, the swelling was less than 5 cm in diameter and regressed totally within 3 days. Mild lethargy and dullness for approximately 24 hours were also noted. Some horses were reported to be partially inappetant, with slightly elevated rectal temperatures. Based on field use in all types of equids (including donkeys) of varying fitness, nutritional status and breeds, the vaccine was considered to be an extremely safe aid to the containment and eradication of EI (EI Epidemiology Support Group 2009).

Glossary

Disease-specific terms

Antigenic drift	Occurs within a virus subtype and involves a series of minor changes, usually point mutations, producing strains that are each antigenically slightly different from their predecessor.
Compartment	An animal subpopulation contained in one or more premises under a common biosecurity management system with a distinct health status with respect to a specific disease for which the necessary surveillance, control and biosecurity measures have been applied.
Equidae	Family of herbivorous mammals including horses, asses, donkeys and zebras.
Haemagglutination inhibition test	A serological test for the presence of antibody in a sample by its ability to inhibit agglutination of red blood cells.
Rendering	Processing by heat to inactivate infective agents. Rendered material may be used in various products according to particular disease circumstances.
Single radial haemolysis	Test to detect the presence of antibody in serum by radial diffusion and precipitation of antibody or antigen.

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, Water and the Environment. There are also observers from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries. The committee provides advice to the National Biosecurity Committee on animal health matters, focusing on technical issues and regulatory policy. *See also* 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, Water and the Environment who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. *See also* Chief veterinary officer
AUSVETPLAN	*Aus*tralian *Vet*erinary Emergency *Plan*. Nationally agreed resources that guide decision making in the response to emergency animal diseases (EADs). It outlines Australia's preferred approach to responding to EADs of national significance, and supports efficient, effective and coherent responses to these diseases.
Carcase	The body of an animal slaughtered for food.
Carcass	The body of an animal that died in the field.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. *See also* Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with OIE guidelines, based on applied biosecurity measures and surveillance, to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. *See also* Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory chief veterinary officers, representatives of CSIRO-ACDP and the relevant industries, and the Australian Chief Veterinary Officer as chair.
Control area (CA)	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Cost-sharing arrangements	Arrangements agreed between governments (national and state/territory) and livestock industries for sharing the costs of emergency animal disease responses. *See also* 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.
Disinsectation	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. *See also* 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. *See also* Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. *See also* Emergency animal disease, Exotic animal disease
Enterprise	*See* 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. *See also* 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. *See also* Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	*See* Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* 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. *See also* Index property
Index property	The property on which the index case is found. *See also* 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. *See also* 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, Water and the Environment as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	*See* Wild animals
OIE Terrestrial Code	OIE *Terrestrial animal health code*. Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: www.oie.int/international-standard-setting/terrestrial-code/access-online.
OIE Terrestrial Manual	OIE *Manual of diagnostic tests and vaccines for terrestrial animals*. Describes standards for laboratory diagnostic tests, and the production and control of biological products (principally vaccines). The current edition is published on the internet at: www.oie.int/en/standard-setting/terrestrial-manual/access-online.
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.
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. *See also* 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 of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. *See also* 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 by-products either of Australian provenance or legally imported for stockfeed use into Australia. (ii) Material containing flesh, bones, blood, offal or mammal carcases which is treated by an approved process.[1] (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. [1] 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 assessment has been undertaken and that is subject to compliance verification. 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.
Swill feeding	Also known as 'feeding prohibited pig feed', it includes: • feeding, or allowing or directing another person to feed, prohibited pig feed to a pig • allowing a pig to have access to prohibited pig feed • the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept • supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig. This definition was endorsed by the Agriculture Ministers' Council through AGMIN OOS 04/2014.
Trace premises (TP)	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).
Tracing	The process of locating animals, people or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Unknown status premises (UP)	A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.
Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products or a synthetic substitute, which is treated to act as an antigen without inducing the disease.

– adjuvanted	A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).
– attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
– gene deleted	An attenuated or inactivated vaccine in which genes for non-essential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A *biological* vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A *mechanical* 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. *See also* 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).
Wool	Sheep wool.
Zero susceptible species premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with OIE guidelines, based on geopolitical and/or physical boundaries and surveillance, to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

Disease-specific abbreviations

b-ELISA	blocking enzyme-linked immunosorbent assay
c-ELISA	competitive enzyme-linked immunosorbent assay
DIVA	differentiate infected from vaccinated animals
EI	equine influenza
HI	haemagglutination inhibition
IA	infected area
PAQ	post-arrival quarantine
PEQ	pre-export quarantine
SPC	compartment for special purposes
SRH	single radial haemolysis

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

Abbreviation	Full title
GP	general permit
IETS	International Embryo Technology Society
IP	infected premises
LCC	local control centre
NMG	National Management Group
OA	outside area
OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
POR	premises of relevance
RA	restricted area
RP	resolved premises
SCC	state coordination centre
SP	suspect premises
SpP	special permit
TP	trace premises
UP	unknown status premises
ZP	zero susceptible stock premises

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