

AUSVETPLAN

Disease Strategy

Equine influenza

Version 3.x, 2010

For industry consultation

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.

Primary Industries Ministerial Council

This disease strategy forms part of:

AUSVETPLAN Edition 3

This strategy will be reviewed regularly. Suggestions and recommendations for amendments should be forwarded to:

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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.

Preface

This disease strategy for the control and eradication of equine influenza (EI) is an integral part of the **Australian Veterinary Emergency Plan**, or **AUSVETPLAN (Edition 3)**. AUSVETPLAN structures and functions are described in the **AUSVETPLAN Summary Document**. This EI strategy provides information about the disease (Section 1), the relevant risk factors and their treatment, and the options for the management of a disease outbreak depending on the circumstances (Section 2) and the policy that will be adopted in the case of an outbreak (Sections 3 and 4). The key features of EI are described in Appendix 3.

This manual has been produced in accordance with the procedures described in the AUSVETPLAN **Summary Document** and in consultation with Australian national, state and territory governments and the horse industry.

EI is included on the OIE (World Organisation for Animal Health) list of notifiable diseases as an equine disease. This obliges OIE member countries that had been free from the disease to notify the OIE within 24 hours of confirming the presence of EI. OIE-listed diseases are diseases with the potential for international spread, significant mortality or morbidity within the susceptible species and/or potential for zoonotic spread to humans.¹

The strategies in this document for the diagnosis and management of an outbreak of EI are based on the recommendations in the *OIE Terrestrial Animal Health Code*² and the *OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*.³

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).⁴

Text placed in square brackets [xxx] indicates that that aspect of the manual remains contentious 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.

Detailed instructions for the field implementation of AUSVETPLAN are contained in the disease strategies, operational procedures manuals, management manuals and wild animal manual. Industry-specific information is given in the relevant enterprise manuals. The full list of AUSVETPLAN manuals that may need to be accessed in an emergency is shown below.

¹ These criteria are described in more detail in Chapter 1.2 of the *OIE Terrestrial Animal Health Code* (http://www.oie.int/eng/normes/mcode/en_chapitre_1.1.2.htm)

² http://www.oie.int/eng/normes/mcode/en_chapitre_1.12.7.htm

³ http://www.oie.int/eng/normes/mmanual/2008/pdf/2.05.07_EQ_INF.pdf

⁴ Information about the EAD Response Agreement can be found at <http://www.animalhealthaustralia.com.au/programs/eadp/eadra.cfm>

In addition, *Exotic Diseases of Animals: A Field Guide for Australian Veterinarians* by WA Geering, AJ Forman and MJ Nunn, Australian Government Publishing Service, Canberra, 1995 (under revision) is a source for some of the information about the aetiology, diagnosis and epidemiology of the disease.

AUSVETPLAN manuals⁵

Disease strategies

- Individual strategies for each of 35 diseases
- Bee diseases and pests
- Response policy briefs (for diseases not covered by individual manuals)

Operational procedures manuals

- Decontamination
- Destruction of animals
- Disposal
- Public relations
- Valuation and compensation
- Livestock welfare and management

Wild animal manual

- Wild animal response strategy

Enterprise manuals

- Artificial breeding centres
- Dairy processing
- Feedlots
- Meat processing
- Poultry industry
- Saleyards and transport
- Zoos

Management manuals

- Control centres management (Parts 1 and 2)
- Animal Emergency Management Information System
- Laboratory preparedness

Summary document

⁵ The complete series of AUSVETPLAN documents is available on the internet at: http://www.animalhealthaustralia.com.au/programs/eadp/ausvetplan_home.cfm

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DRAFT

1 Nature of the disease

Equine influenza (EI) is an acute, highly contagious, viral disease, which 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.

1.1 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 latter 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).

1.2 Susceptible species

EI viruses infect all species of the family Equidae (ie 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 2004, an influenza A subtype H3N8 virus was isolated from racing greyhounds with severe respiratory disease in the United States. Seroconversion to the virus was demonstrated, and experimental inoculation studies confirmed its aetiological role in respiratory disease in dogs. The isolate was shown by genetic sequence analysis and phylogenetic comparisons 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).

In 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 had serological evidence of influenza infection. All dogs recovered (Crispe et al 2010).

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 outbreaks of EI in horses in USA (McQueen et al 1966, Davenport et al 1967) or in Australia in 2007.

1.3 World distribution and occurrence in 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 new 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 of an avian influenza virus in horses was suspected, implying susceptibility of horses to some avian H3N8 strains (Guo et al 1992).

Australia had been free of EI until August 2007, when the disease was introduced with imported horses (Watson et al 2010a, Kirkland et al 2010). The causative virus, called A/Equine/Sydney/07 H3N8 (Watson et al 2010b), 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). Iceland and New Zealand are the only countries with substantial equine populations never to have reported EI.

See http://www.oie.int/wahid-prod/public.php?page=disease_outbreak_map for the most up to date information on the global EI situation.

1.4 Diagnostic criteria

1.4.1 Clinical signs

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 due to 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 1966, Gerber 1970, Dups et al 2010, Faehrmann et al 2010).

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 purpura haemorrhagica or occurs in older horses and donkeys 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 still births and dystocias in mares exhausted from paroxysmal coughing (Gilkerson 2010).

1.4.2 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 to 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, followed sometimes 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).

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).

1.4.3 Laboratory tests

Specimens required

Confirmation of diagnosis may be made by detection of virus or virus product from nasopharyngeal swabs or nasal swabs; or by serology in live animals.

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

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 as they do not contain antibiotics or antifungal agents.

Transport of specimens

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 -20C as viability is significantly less than at 4C, or at colder (dry ice) temperatures. Serum must be removed from clotted blood samples before freezing. For further information, see the **Laboratory Preparedness Manual**.

Specimens should initially be sent to the state or territory diagnostic laboratory, from where they will be forwarded to the CSIRO Australian Animal Health Laboratory (CSIRO-AAHL), Geelong for emergency disease testing, after obtaining the necessary clearance from the chief veterinary officer (CVO) of the state or territory of the disease outbreak and after informing the CVO of Victoria about the transport of the specimens to Geelong.

Laboratory diagnosis

Available diagnostic tests

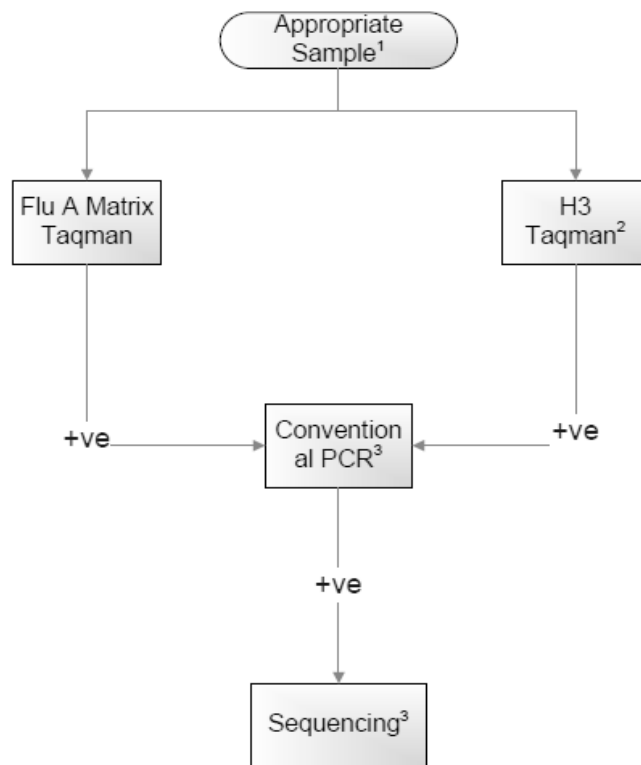
The diagnostic tests currently available at CSIRO-AAHL are shown in Figure 1 and Table 1.

EI virus can be isolated from nasal swabs by culturing processed samples in specific pathogen free (SPF) embryonated chicken eggs and/or Madin Darby canine kidney (MDCK) cells (OIE 2008). Virus growth is indicated by haemagglutination tests, and the haemagglutinin and neuraminidase type is determined by specific antisera and molecular tools.

Virus isolation must 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. Currently, CSIRO-AAHL can perform full-length gene sequencing for this purpose.

During the 2007 outbreak of EI in Australia, the principal molecular diagnostic tool for early detection of EI was a Taqman-based real-time reverse transcription polymerase chain reaction (RT-PCR) assay developed to detect all Type A influenza viruses. This assay was developed specifically in response to avian influenza preparedness and was transferred to all Australian state and territory veterinary laboratories (Heine et al 2005, Heine et al 2007). The Type A real-time RT-PCR assay was validated for detection of EI in nasal swabs using nested RT-PCRs which targeted a different area of the viral genome (Oakey et al, 2007).

Figure 1



- 1. Nasal swabs
- 2. Not performed on routine quarantine samples
- 3. At start of an outbreak/selected isolates

A novel equine H3 specific real-time RT-PCR assay was also developed at the beginning of the 2007 Australian outbreak (Foord et al 2008). The assay was based on partial HA sequence alignment of A/Equine/Sydney/2888-8/2007 with sequence from all equine influenza Genbank entries available in August 2007. The assay was designed for detection of all known recent H3 strains. It was validated using data generated from an antigen detection ELISA, the Type A real-time RT-PCR assay and virus isolation from nasal swabs collected daily from experimentally infected horses. The H3 specific real-time RT-PCR assay proved to be more sensitive than the Type A specific RT-PCR assay, and at AAHL continued to be used in parallel with the Type A RT-PCR assay throughout the outbreak. When used in negative populations (n= 489 horses), the H3 specific real time RT-PCR assay had a diagnostic specificity of 98.8%. It has been shown to have a relative diagnostic specificity of 74% and a relative diagnostic sensitivity of 98% when comparing results to a H3N8 conventional RT-PCR (EI Epidemiology Support group (2009).

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

During the 2007 outbreak of EI in Australia, a competitive ELISA (C-ELISA) for avian influenza antibodies was modified as a blocking ELISA (b-ELISA) and validated for detection of EI virus antibodies in horses (Jeggo et al., 2008). A significant advantage of the C-ELISA is that it allows differentiation of naturally infected horses from horses vaccinated with the recombinant canary pox vaccine (ProteqFlu®, Merial). The C-ELISA technology was distributed to state laboratories to allow testing to be done locally rather than submitting sera to AAHL.

The performance of the b-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).

Table 1 Laboratory tests currently available at CSIRO-AAHL for the diagnosis of equine influenza

Test	Specimen required	Test detects	Time required
<i>Agent Detection</i>			
qRT-PCR	nasal swabs or cultured virus	Influenza type A viral RNA	4 hours
qRT-PCR	nasal swabs or cultured virus	H3 Influenza viral RNA	4 hours
<i>Agent Characterisation</i>			
RT-PCR	nasal swabs or cultured virus	Subtype-specific viral RNA	1 day ^a
Virus isolation using embryonated eggs or cell cultures and identification	nasal swabs in virus transport medium	virus/differential diagnosis of other equine respiratory viruses	5–10 days
Immunoassays	virus isolate-containing samples	H and N subtypes	1 day ^a
Electron microscopy and immuno- EM	tissues , culture material	Specific virus	1 day
<i>Serology</i>			
Nucleoprotein b- ELISA	serum	Group reactive antibody	1 day
Hemagglutination Inhibition	serum	Serotype specific antibody	1 day

a conventional, nested RT-PCR for H3N8 and H7N7 subtypes (Oxburgh and Hagstrom (1999).

b Excluding culture time

ELISA = enzyme-linked immunosorbent assay

RT-PCR = reverse transcription polymerase chain reaction

qRT-PCR = Real time RT-PCR

Source: Information provided by CSIRO-AAHL, 2010 (refer to CSIRO-AAHL for most up-to-date information).

Comparison of diagnostic tests

Real time PCRs are the most sensitive tests available for detecting the virus and are available in State/Territory laboratories.

Serology is useful for retrospective confirmation of infection, but and 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.

Influenza A screening real time PCR and serology at CSIRO-AAHL and state laboratories is coordinated under the LEADDR (Laboratories for Emergency Disease Diagnosis and Response) program, a collaborative program of test harmonisation and quality assurance.

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 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-AAHL.

1.4.4 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 non-infectious 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 herpes viruses 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; and
- Hendra virus infection.

1.4.5 Treatment of infected animals

Currently, there is no specific antiviral treatment registered for use for treatment of EI. Although expensive, antiviral drugs developed for human use could conceivably be used in the future for the prevention of disease or the treatment of 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 et 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 complete rest is recommended after infection, with a longer period being required if the fever extends for more than 4 days. After 30 days 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 non-steroidal 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).

1.5 Resistance and immunity

1.5.1 Innate and passive 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.

1.5.2 Active 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, in that 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 the 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 cELISA assay can differentiate between increases in antibody levels due to vaccination and increases due to infection (See Section 1.4.3).

1.5.3 Vaccination

Potent EI vaccines containing virus strains epidemiologically relevant 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 sub-clinically 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 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 pre-challenge SRH antibody level is ≥ 140 – 150 mm² (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 adequate.

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 vaccine⁶, 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/attenuated-live influenza virus vaccines raises concerns due to the potential for reassortment of influenza virus with a co-circulating wild-type

⁶ FluAvert™ I.N. Vaccine, Heska Corporation www.heska.com

virus and subsequent loss of attenuation and/or emergence of a new highly pathogenic influenza virus (Paillot et al 2006). The cold-adapted equine influenza 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 equine influenza vaccine, virus was detected in nasal secretions from ponies for up to seven days post-vaccination (Lunn et al 2001).

A recombinant canary pox vectored EI vaccines⁷ 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 to 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 conducted by Bryant et al (2010) ponies were challenged experimentally with A/Equine/Sydney/07 only two weeks after the second vaccination of a primary course of two doses ProteqFlu™ recombinant vaccine administered 5 weeks apart. Four of five vaccinated ponies shed live virus for 1 to 2 days post infection with two of the ponies excreting a peak titre of 1.5 log₁₀ EID₅₀ /mL 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 canarypox recombinant vectored vaccine (EIEpidemiology Support Group 2009).

More frequent booster administration is recommended in high risk situations as this schedule may not maintain protective levels of antibody (OIE 2008b). Boosters

⁷ ProteqFlu™, Merial (which was used during the 2007 EI outbreak in Australia) contained two recombinant canarypox viruses expressing the haemagglutinin of A/eq/Kentucky/94 (American lineage, H3N8) and A/eq/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.

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 et al 2005).

During the 2007 outbreak in Australia, a canarypox recombinant 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 non-infected 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, In Press)

In countries where EI is endemic, clinical protection of foals can be enhanced 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 and therefore it has been recommended that primary courses of inactivated vaccine in foals be delayed until maternal antibody has completely disappeared (i.e. 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 heterogeneity to the challenge strain may contribute to vaccine breakdown (Park et al 2004; Daly et al 2003; Park et al 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).

Modelling studies predict that, if a population has all been vaccinated with the same strain of the virus as an infecting strain, outbreaks begin occurring when there were two or more amino acid differences and, the size of the outbreak increases with the number of amino acid differences. When the vaccine and infecting strains come from within the same antigenic cluster, large outbreaks are rare. Conversely, when the two strains are from different clusters, large outbreaks occur with a probability approaching 0.5 and can result in infection of around 70% of the population (Park et al 2009).

EquiFluNet⁸, the Global Surveillance Network for Equine Influenza, hosted by the Animal Health Trust, Newmarket, England, 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 2.

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).

On-going 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 (CIE 2007). In addition to the on-going 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 any 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 ten times higher than the least expensive control option. The least cost option involved maintaining effective quarantine measures to exclude EI, a pre-arranged vaccine supply agreement which 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.

⁸ <http://www.equiflunet.org.uk/>

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; and
- 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 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 susceptible; this could generate new epidemics, especially if horses are moved illegally within and from the 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 1.6.4) 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 vaccination would commence 7 days from the onset of a control program. The model indicated that ring vaccination for 1 Km around Infected Premises (IP) 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 the numbers increasing as the amount of vaccination 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 in press).

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 2 for further discussion of EI vaccination.

1.6 Epidemiology

1.6.1 Incubation period

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

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

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

For regulatory purposes, the OIE *Terrestrial Animal Health Code* gives a maximum infective period of 21 days.

1.6.2 Persistence of agent

General properties

The 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 (Prince and Prince 2001). Influenza viruses are protected in the presence of organic matter which enhances resistance to physical and chemical inactivation. Organic material should be removed so disinfectants can work optimally (Swayne and Halvorson 2003).

Environment

EI virus is inactivated by exposure to ultraviolet light for 30 minutes, by heating at 50°C for 30 minutes, by ether and by acid (pH 3). 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; and
- soil under sunlight at 15°C for 8 hours.

Live animals

No unique mechanism for inter-epidemic propagation of EI viruses 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 less virus than clinical cases and are not persistent shedders.

Spread by equine semen or embryos has never been reported during field outbreaks.

Animal products and byproducts

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 that 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.

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.

Equipment and personnel

Influenza viruses can survive on skin, fabrics and the surface of contaminated equipment. In conditions of 35% to 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 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 outer lipid envelope of the virus. 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 enhances resistance to physical and chemical inactivation. Where possible, organic material should be removed so 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 **Decontamination Manual**.

Vectors

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

1.6.3 Modes of transmission

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 in conditions of high relative humidity.

There are varying views regarding the importance of windborne spread in EI transmission (EI Epidemiology Support Group 2009). Windborne spread from premises over distances 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 radius of an infected racing complex became infected after an unexpected change in the prevailing wind, in 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).

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 prior to the imposition of the standstill, infected horses moved from Maitland to Warwick (approx 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 EIV 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 qRT-PCR for 3 consecutive days (Crispe et al 2010).

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

However, mechanical transfer of EI virus on people, clothing and equipment is a significant route of virus spread (see below). In the 2007 Australian outbreak, new cases more than 5km 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 option determined was transfer of virus from horse to human to human to horse. This mechanism of spread was not substantiated.

There is no evidence that equine semen or embryos are involved in the transmission of EI.

Animal products and byproducts

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.

Transmission of EI virus to a foxhound pack associated with ingestion of raw horse meat 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).

Equipment and personnel

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.

Contaminated horse transport vehicles, in particular, 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 from state to state.

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.

After the 2007 Australian outbreak a retrospective cohort study was conducted to investigate the effectiveness of personal biosecurity and hygiene measures undertaken by eleven individuals who were caring for horses at an infected and quarantined facility containing 255 horses and who exited that facility to care for horses on other properties. No cases of EI occurred on other properties that were attributed to movements by people exiting the quarantine facility (Frazer, Perkins and Pitt, 2010). Arthur and Suann (2010) reported on biosecurity precautions at four racetracks in and near Sydney. For at least four weeks the racetracks remained uninfected, but non-compliance with the biosecurity precautions eventually led to infection.

Vectors

Only equine species are involved in virus replication. Disease transmission by passive mechanical vectors such as insects, birds and rodents is highly unlikely (see Section 1.6.2). 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. 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 is no data to support this conclusion in the veterinary literature.

1.6.4 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 due to 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 which 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 relatively 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 south east Queensland but, due to movement restrictions, other Australian states and territories remained unaffected.

Compared to 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 NSW and Qld epidemic curves had both peaked before substantial vaccine-induced immunity could have developed in equines vaccinated 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 over 80% of model realisations, fewer 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 on average from 1.0 to 0.47. 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 1.5.3). There is little objective information available about the influence of environmental factors on the spread of EI. Outdoor extensive management systems, with horses widely dispersed in 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 1.6.3).

High stocking density, enclosed housing and air-conditioning 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.

1.7 Manner and risk of introduction to Australia

EI entered Australia in 2007 via a quarantine breakdown. An official enquiry concluded '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 quarantine procedures are inadequate. Subsequent to the 2007 incursion, Australia has enhanced quarantine requirements for importation of live horses to reduce the likelihood of the 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 negligible risk.

2 Principles of control and eradication

2.1 Critical factors assessed in formulating response strategy

Features of the disease

- Equine influenza (EI) is an 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.
- There are other respiratory conditions with similar clinical signs to EI, but which can be distinguished from EI by the absence of rapid spread within a group. In naïve horses, clinical signs are easily recognisable once an initial diagnosis has been made. However, severity of clinical signs is highly variable. Inapparent infections can occur, especially in paddocked horses not in work.
- The incubation period is 1 to 5 days, infected animals shed virus for a maximum of 7-10 days and there is no known carrier state. Exposure to higher challenge doses of virus shortens the incubation period, increases the duration of virus excretion and produces more severe clinical signs.
- EI virus does not survive long outside the host and climatic conditions will influence the rapidity of disease spread. It is inactivated by exposure to ultra violet light for 30 minutes and a range of disinfectants and chemicals.
- Only equine species (horses, donkeys, mules and zebras) are known to transmit disease but dogs in close contact with horses may become infected and show typical influenza clinical signs. There are no public health implications.
- Predominant methods of spread in decreasing order of importance are the movement of live infectious horses, fomites and aerosols (local spread). Windborne spread over longer distances may occur in some situations. Disease transmission by genetic material, insects, birds and rodents is highly unlikely.
- Factors influencing the size and duration of an outbreak include: its location; horse density in the area; time of year (which affects the magnitude of horse movements, disease transmissibility and the persistence of virus in the environment); number of tracings from the infected property; and the likely source of infection.

Vaccination issues

- Some vaccines give some protection against clinical disease as early as 3-5 days after the initial dose, but the usual period is 7-14 days. A shorter vaccination interval may temporarily improve the anamnestic response.
- Immunity from natural infection is stronger and longer-lasting than that from vaccination.
- The value of predictive vaccination of enterprises and populations of horses that could be expected to contribute most to future transmission of disease because of

the proportionately larger number of movements of people and other items (equipment, feed, vehicles) is unclear.

- Vaccination may be prioritised in specific compartments of horse populations to mitigate consequences in infected and unaffected areas by facilitating horse movement and economic activity; and/or more widely if initial control methods have failed, and the disease has spread beyond the original RA and is likely to become endemic.
- A DIVA approach is possible with some vaccines.
- Modelling studies indicate the early introduction of vaccination may slow spread, with vaccination of all horses within 1-3 km of infected premises the most effective approach.
- EI vaccines containing virus strains epidemiologically relevant to the outbreak strain can limit the magnitude and duration of virus shedding, decrease the severity of clinical signs and reduce the aerosol spread of virus by coughing horses. If the outbreak strain is heterologous to vaccine strains, field challenge of vaccinated horses with sub-optimal immunity can produce sub-clinically infected horses and delay the recognition of outbreaks in new areas.
- Technical issues relating to the registration of some vaccines may lead to delays in availability unless prior approval has been gained.
- Any EI incursion will probably involve the H3N8 subtype which has recently shown significant antigenic drift.

Features of the susceptible populations

- 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.
- There are numerous horse industry organisations reflecting this diversity but nevertheless large numbers of horse owners do not belong to any breed or activity organisation. Disparate sectors have differing risk appetites, differing priorities and often find it difficult to achieve consensus. Different communication methods to those routinely employed will be needed.
- The nature of the horse industry may make the imposition of an effective national standstill difficult.
- 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 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 EI will have a severe social impact.

- Many horse owners and carers (especially small holders) are unfamiliar with government animal health procedures compared to 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.

2.2 Options for control or eradication

Based on the above factors, managing an incursion of EI may require the use of some or all of the following strategies:

- A widespread standstill of all horses (including vaccinated horses) for at least 72 hours immediately after the initial diagnosis.
- Application of enhanced biosecurity - horse enterprise and personal.
- Saturation communication of key messages to the industry and general public: movement controls, prevention of spread through appropriate biosecurity measures, vaccination, animal welfare, the importance of reporting suspect disease and the purpose of the industry/ government program.
- The early implementation of appropriate zones and compartments (eg racing), and their modification on a risk assessment basis.
- The early determination of the extent of infection through the rapid identification of infected and potentially infected premises using quickly instituted surveillance and tracing of horses.
- The swift declaration and effective policing of nationally harmonised control areas.
- The rapid imposition of quarantine and movement controls on infected and potentially infected premises; their regular review to maximise opportunities for business continuity.
- The gaining of smallholder support.
- Prompt strategic vaccination utilising a DIVA approach.
- Active 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.

The policy options for management of an EI incursion, based on consultation and cooperation between government and the horse industry, are:

- do nothing;
- eradication;
- containment, with a view to eventual eradication;
- recognition of endemic status - long-term control through a horse industry based program utilising compartmentalisation, vaccination and enhanced biosecurity.

DRAFT

3 Policy and rationale

For the purposes of this disease strategy, the **initial case definition** of EI is 'a high morbidity rapidly spreading respiratory disease in a group of horses, with laboratory confirmation by 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'.

3.1 Introduction

Summary of policy

Equine influenza (EI) is an 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 due to 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.

Equine influenza is a Category 4 disease under the government-industry Emergency Animal Disease Response Agreement for cost-sharing arrangements. Category 4 diseases are those for which costs will be shared 20% by government and 80% by industry.

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/ compartmentalisation* system as soon as possible to define infected and disease-free areas and premises;
- ☞ strategic use of a vaccine with DIVA capability;
- ☞ *decontamination* of facilities, equipment and other items;
- ☞ enhancement of 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 enhance understanding of the issues, to facilitate cooperation and to address animal welfare issues; and
- ☞ 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 (equipment, feed, vehicles) moving onto and off such properties, potentially from and to other properties holding horses;
- ☞ preventatively, 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; and/or
- ☞ more widely if initial control methods have failed, and the disease has spread beyond the original restricted area (RA) 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 enhanced biosecurity, long-term compartmentalisation and vaccination.

The chief veterinary officer (CVO) in the state or territory in which the outbreak occurs is responsible for instituting initial control action under state / territory legislation and for developing an Emergency Animal Disease Response Plan for the particular outbreak.

The Consultative Committee on Emergency Animal Diseases (CCEAD), convened for the incident, assesses the response plan drawn up by the CVO for technical soundness and consistency with AUSVETPLAN, and endorses or seeks modifications to it. Overall operational management of the incident rests with the CVO of the affected jurisdiction, with oversight by the CCEAD.

The National EAD Management Group (NMG), also convened for the specific incident, decides on whether cost sharing will be invoked (following advice from the CCEAD) and manages the national policy and resourcing needs.

For further details, refer to the **Summary Document**.

CVOs will implement disease control measures as agreed in the EAD Response Plan and in accordance with relevant legislation. They will make ongoing decisions on follow-up disease control measures in consultation with the CCEAD and the NMG.

For information on the responsibilities of the state or territory disease control headquarters and local disease control centres, see the **Control Centres Management Manuals**.

3.2 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 / 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.

3.2.1 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.

3.2.2 Quarantine and movement controls

Quarantine and movement controls will be imposed at the level of premises and declared areas. Detailed guidelines for classifying and managing premises and areas are set out in Section 4.

Premises quarantine

When EI is initially suspected or confirmed in a jurisdiction, movement of horses onto and off individual Infected Premises (IPs), Suspect Premises (SPs), Dangerous Contact Premises (DCPs) and Trace Premises (TPs) will be immediately controlled and appropriate biosecurity measures 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 below).

Horse movement standstill

The initial response to strong suspicion or confirmation of EI in an affected jurisdiction/s will be the immediate declaration of a widespread standstill prohibiting all new live horse movements into, out of or within a declared area/s unless a specific permit has been issued. Continued movement of horses, in transit at the time the standstill is declared, may be allowed depending on the risk presented by the journey (see section 4.2).

The standstill will initially be triggered in the affected jurisdiction/s as soon as laboratory diagnosis is confirmed or, based on strong suspicion, where circumstances warrant. The standstill will become more widespread after CCEAD

agreement and advice to NMG, and will be implemented in each jurisdiction through the relevant State / Territory legislation.

The duration of any standstill will depend on the circumstances of the incursion, but an initial minimum period of 3-7 days is recommended. 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.

Zoning and compartmentalisation

When/if it is confidently established that EI has been introduced only to a defined area of Australia, nationally harmonised risk-based zoning / 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 size of 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.

Declared zones (based on the risk of infection with EI) will be established as follows:-

1. Restricted Areas

Areas that contain active EI infection will be classified as Restricted Areas (RAs). The restricted area (RA) must contain all IPs and DCPs and, where practical, SPs and TPs. More than one RA may be required. The RA boundary will normally be at least 10km from the nearest IP boundary.

The size of the RA may be modified once the extent and distribution of IPs are reasonably clear. If infection spreads widely or neighbouring RAs overlap, a much larger RA may be declared. Within an RA, it may be useful for disease management and business continuity purposes to combine individual IPs into a larger IP which would be operated as a compartment for special purposes (SPC) or infected area.

2. Control areas

A control area (CA), based on state or territory borders in the first instance (or wider if appropriate), will be imposed around the RA to control movements of horses and to maintain a buffer between infected and free areas.

The CA borders will be reduced and movement restrictions eased as soon the extent of infection has been confidently defined to focus control efforts, reduce resource commitments and reinstate normal horse industry activities.

3. Areas outside declared areas

An area outside the above declared areas, considered to be free of EI and with restrictions on the entry of horses from declared areas, will be identified.

Zoning/ compartmentalisation for international trade

There are no criteria in the OIE *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 for the maintenance of biosecurity while minimising the 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 a SPC in order to maintain biosecurity while minimising disruption to its normal commercial activities.

Acceptance of a zoning / 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.

3.2.3 Tracing and surveillance

Tracing

The first reported case may not be index 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 1.6.2). 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 IPs, DCPs, SPs and 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;

- horse equipment (including saddles, bridles and bits, grooming equipment, riding clothes, stable tools) during the 3 days before the first signs of clinical infection;
- 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; and
- movements of semen and embryos (not a high priority for tracing) apart from tracing of collecting personnel involved 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 3), 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 pyrexia horses should be included, as they are useful for establishing a provisional diagnosis (see Section 1.4.3).

However, following an initial diagnosis of EI in an RA, verbal reports meeting the response case definition (See Section 3) may be sufficient to classify a premises as an IP within that RA, especially if the premises are close to an existing IP. At the height of an epidemic, it is not 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 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 and overalls) must be worn when collecting biological samples from horses and 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 Appendix 1 for further details of procedures for surveillance and proof of freedom requirements.

3.2.4 Vaccination

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 distinction between infected and vaccinated horses (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 country 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 in SPCs or infected areas, targeting high-risk enterprises and dense horse populations that may contribute significantly to future spatial transmission of infection;
- blanket vaccination in SPCs or infected zones to increase population immunity and encourage the disease to 'burn out';
- preventative 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 has occurred. All vaccinated horses should be permanently identified.

See Appendix 2 for further discussion of EI vaccination supply, strategies and procedures.

3.2.5 Treatment of infected animals

Supportive treatment of horses, while necessary (see Section 1.4.5), will do nothing to limit the spread of infection.

3.2.6 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 1.6.2). Within the RA, horsemeat and offal should be cooked before use as pet food.

3.2.7 Disposal of animal products and byproducts

EI virus does not survive long outside the host and is rapidly inactivated by sunlight (see Section 1.6.2). 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 (see the **Disposal Manual**).

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.

3.2.8 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 1.6.2.

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 and 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, the CA or 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.

3.2.9 Wild animal control

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 **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.

3.2.10 Vector control

Vector control will not be a response priority.

3.2.11 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 jurisdiction/s 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 e.g. racing and breeding sectors, pleasure and performance sector and horse industry service providers including private veterinary practitioners, farriers and equine dental technicians etc, as needed.

Because of the disparate/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 rationale for and progress with the program, and to seek local information to fine tune operations.

The potential for local spread will be reduced by detailed public awareness programs emphasising biosecurity, and through the distribution of equipment 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 education such as sampling and handling protocols. It is critical that a wide variety of industry-related organisations and service providers are 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 via the media.

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

Special 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 should be placed on web and email based information dissemination and acquisition and on hotlines to deal with the likely volume of requests; and

- special liaison officers should be appointed to deal with groups of people quarantined with their horses away from home e.g. 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 equine influenza 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 **Communications Manual** for further details on what should be included in a public awareness campaign.

3.3 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 eradicated 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 non-racing sectors of the horse industry. The thoroughbred racing industry employs an estimated 66,480 full-time equivalents (IER 2007). Horses are also an important resource for human recreation, tourism and amenity and are used for many commercial and private purposes by the non-racing 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 2008a; 2008b). Disruption of normal social life, which for many recreational owners revolves around weekend horse meetings and contacts with other horse associated people, 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 – standstill, movement controls, zoning, property quarantine and personal biosecurity – are inevitably 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 intents 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 (EIAP), to assist 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 EIAP so the true costs and economic impacts were far higher. The

losses of general and wagering tax revenues by Federal 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.

In any future outbreak, race meetings and other horse events will be cancelled during the first wave of infection because of movement controls and a ban on the assembly of horses to minimise disease spread. Once infected, a racehorse cannot race for at least 3 months and this will severely affect any groups of racehorses held at racecourses which become infected. There will be consequential loss arising from lost opportunities for show, competition or racetrack success.

Racing cancellations will severely affect income for governments, race clubs, owners, trainers, jockeys, farriers, bookmakers, race club staff, horse transport companies and wagering companies. The economic impact of racing cancellation would be greatest during periods of major events. Losses of prize money will be incurred by owners and trainers. Owners will incur veterinary treatment costs and have to pay for the maintenance of horses remaining in a trainer's stable, unable to move to agistment because of movement restrictions.

Infection at a major metropolitan thoroughbred training track would have a considerable effect on racing and training, particularly when a 10-kilometre RA is imposed around the track. Horses stabled away from the track might not be able to gain entry to communal training facilities for a protracted period, depending on specific movement controls and vaccination policies implemented in different compartments of horses. Harness racing and training would be less affected because of the larger number of smaller private stables and lower use of communal training facilities.

Other equestrian activities of economic significance might be postponed or cancelled, with consequent economic loss. Un-infected riding schools would be less affected if horses used for lessons do not leave the premises and appropriate decontamination procedures are followed to prevent mechanical transmission of virus. The cancellation of equestrian events such as shows, other competitions and pony clubs has a major impact on the income of community organisations and small businesses especially in rural areas, and could result in some organisations and businesses ceasing to operate if movement controls are sustained for long periods of time, or if they result in key annual events being cancelled.

In the breeding sector, mares may be delayed in moving to studs for foaling or service, and stallion owners might be disadvantaged by poor bookings. Breed organisations which allow transport of semen will be less severely affected. Stallion infertility induced by fever is an occasional consequence of EI, but is rare. Mortality rates from EI of up to 40% in foals aged less than one month have been reported overseas but mortality in perinatal foals was rare in the 2007 Australian outbreak. Movement restrictions on horses visiting studs will increase the agistment costs of breeders and disrupt breeding programs. The projected impact on the future year's foal and then yearling crops of a major reduction in thoroughbred coverings was a key driver for the creation of a Purple Zone in NSW during the 2007 Australian outbreak.

Horse transport companies would suffer considerable losses as a result of cessation of all horse movement. Outside the RA, transport costs would increase because of

the need for regular and thorough decontamination of horse transport vehicles and equipment.

There will be substantial disruption to income for farriers, horse dentists, saddlery shops and other businesses servicing the horse industry due to reduction of business during the standstill and zoning periods, as well as increased personal biosecurity provisions which may be hard to reconcile with previous practices.

Equine veterinary practices will be variably affected depending on their location inside or outside of control zones and whether they become involved in the official response.

In the longer term, if EI became endemic in Australia, the costs associated with the disease would continue and arise from the substantial and on-going costs of vaccination, management of passport systems and loss of productivity from repeated disease outbreaks. It is likely that major horse industry organisations would require that all competition horses be regularly vaccinated. The cost of surveillance to monitor strains and antigen drift would be reflected in the cost of vaccination.

An Australian cost analysis of equine influenza response scenarios (Beale et al 2009) estimated the total number of active Australian racing and event horses to be about 330 000, with a further 602 500 recreational horses. At least three doses of vaccine per horse would be required in the first year to vaccinate the racing and event population alone and one or two booster doses per year thereafter. It assumed that vaccine would cost \$30 per dose, that veterinarians would charge \$90 to administer each vaccine dose, issuance of a passport would cost \$50 and attract an on-going administration cost of \$10 per passport.

Emergency response costs

Roe (2001) examined the likely costs of an emergency response to a hypothetical outbreak of EI in Victoria. The hypothetical outbreak was detected early and eradicated before it became widespread – an optimistic scenario. The emergency response was based on quarantine of IPs, cessation of all horse movement and assembly, tracing and surveillance of contacts, and vaccination of all horses of all breeds on DCPs and within the RA.

The total cost of the response to a limited outbreak involving three IPs was estimated to be \$775 840 without additional vaccination of all Victorian racehorses in training, and \$3 740 540 if all thoroughbred and standardbred racehorses in training were vaccinated (assuming adequate supplies of vaccine were available and vaccination costs were covered). Response costs for an alternative scenario involving a large-scale outbreak with 30 IPs and additional vaccination of all thoroughbred and standardbred racehorses in training in Victoria were estimated to be \$6 136 410. The report did not estimate a cost for mass vaccination of Victorian horses of breeds other than racehorses.

Actual eligible emergency response costs in 2007/08 were approximately \$100 million highlighting the difficulty of prospective cost benefit analyses. Indirect and flow-on costs were estimated to have been more than \$1 billion (Messara 2008). Examination of the cost components of this outbreak shows that, in retrospect, some elements, such as vaccination in non-infected states, did not contribute to the success of the eradication campaign, and could therefore have been omitted,

making the program less costly. However at the time, in the face of a propagating outbreak, these costs were seen as justifiable insurance against extension of the disease into non-infected high value populations, protecting the iconic Melbourne Cup and similar races.

Trade

There may be an initial short-term ban on all exports of equines and used equipment to some countries until the disease areas have been well defined, effective controls are in place and conditions for resumption of trade have been negotiated. Additional costs will be incurred for horses exported to New Zealand (which is free from EI) due to the likely imposition of periods of pre-embarkation and post-arrival quarantine. During the 2007 outbreak, additional costs of about \$5000 per horse were incurred and there was a sharp decrease in the volume of horses exported to NZ due to the limited space available in post arrival quarantine facilities. Normal trade with New Zealand was not resumed until Australia met OIE requirements for declaration of country freedom in late December 2008.

Import conditions will not be affected in the short term while control and eradication are attempted. If a decision is made to declare EI endemic, a review of import quarantine conditions will be necessary, which could lead to a decrease in import quarantine costs.

Cost-benefit analysis

During the eradication phase of the 2007 Australian EI outbreak, a number of economic assessments were carried out, to support decision making by NMG as to whether extra expenditure above various threshold amounts should be approved. These assessments included contemporaneous estimates of what the disease was costing as well as estimated control and eradication costs for different scenarios, which included the feasibility of success, and were in effect rolling prospective cost benefit studies. In each case NMG took the decision to authorise further expenditure and this resulted in the successful eradication of the disease. However, a comprehensive national retrospective cost benefit study of the 2007 Australian outbreak and response has not yet been undertaken (2010).

A cost benefit study (Frontier Economics 2008) of the results of keeping EI out of Victoria during the 2007 outbreak and maintaining the Spring Racing Carnival estimated that the racing sector incurred \$48 million in costs but avoided extra costs of \$92-142 million, the equestrian sector avoided an extra \$39 million of costs at a minimum, and the Victorian government expended \$12 million but avoided an extra \$25 million in control costs. These figures do not include costs incurred by the thoroughbred breeding or the harness racing sectors.

Cost-benefit analysis of EI response options has been examined in New Zealand (Harris Consulting 2000, Anon 2002). They estimated that the economic impact of EI establishment in New Zealand over the next 30 years at net present value (8% discount rate) would be NZ\$157 million. Eradication costs were estimated at NZ\$53 million. Another discussion paper produced in 1997 estimated the total cost of leaving the disease uncontrolled for 10 years at NZ\$270 million. Direct costs to government associated with eradication activities were estimated to be NZ\$12 million. The conclusion from both studies was that successful eradication of EI resulted in a benefit:cost ratio of > 1.

In December 2007 a review of the Harris Report was carried out by NZIER (Nixon, 2007), updating the costs and benefits of several scenarios and control options for EI occurring in Australia and /or New Zealand, in light of the Australian outbreak which was not yet controlled at that time. This analysis showed that eradication of a small, medium or large EI outbreak in New Zealand would be less costly than either doing nothing or containing but failing to eradicate the disease. It also revealed that it would be cost effective to maintain effective quarantine barriers to prevent all but the smallest outbreak, even in the event of Australia failing to eradicate the disease.

This report also considered the possible value of undertaking pre-emptive vaccination of New Zealand horses to reduce the impact of an EI incursion. It showed that "mass vaccination is an expensive option relative to maintaining border quarantine controls or responding to an incursion unless the chances of an incursion are high. Furthermore, if pre-emptive vaccinations were undertaken and quarantine barriers were withdrawn, it is almost certain that EI would enter New Zealand, increasing costs further".

Impact on other sectors

Other livestock commodity groups would be only marginally affected by EI or measures to control it. Movement controls would prohibit the movement of some horses used for mustering and in the 2007 Australian outbreak, some cattle booked in at abattoirs could not be mustered. Significant impacts on conservation or the environment are not likely. However, some rural community organisations and small businesses will likely be severely impacted as outlined above.

3.4 Criteria for proof of freedom

Demonstrating freedom from disease in previously infected areas 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 and their ownership and their location are required to plan and implement a surveillance program to demonstrate freedom from EI. For details of methods used to establish a sampling frame during the 2007 Australian outbreak, see Appendix 2.

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.

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, 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.

See Appendix 1 for further details on procedures for surveillance and proof of freedom.

3.5 Funding and compensation

EI is classified as a Category 4 emergency animal disease under the Emergency Animal Disease (EAD) Response Agreement between the governments of Australia and the livestock industries. The horse industry is not currently a signatory to the EADRA.

Category 4 diseases are diseases that are classified as being mainly production loss diseases. While there may be international trade losses and local market disruptions, these would not be of a magnitude that would be expected to significantly affect the national economy. The main beneficiaries of a successful emergency response to an outbreak of such a disease would be the affected livestock industries. For this category, the costs will be shared 20% by governments and 80% by the relevant industries (refer to the EADRA for details).⁹

Information on the cost-sharing arrangements can be found in the **Summary Document** and in the **Valuation and Compensation Manual**.

3.6 Other policies

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 may not occur in the absence of an agreed government/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 it 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 government and the horse industry, however, from experience in other countries, it is unlikely to succeed.

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 enhanced biosecurity, long-term compartmentalisation and vaccination.

⁹ Information about the EAD Response Agreement can be found at <http://www.animalhealthaustralia.com.au/programs/eadp/eadra.cfm>

4 Recommended quarantine and movement controls

4.1 Guidelines for classifying declared areas and premises

A declared area is a part of a country with defined boundaries that is subject to mandatory disease control measures (such as animal movement controls, animal destruction, decontamination) under emergency animal disease legislation. Types of declared areas include restricted area (RA) and control area (CA); declared premises include infected premises (IP), dangerous contact premises (DCP), trace premises (TPs) and suspect premises (SP). Not all classifications are relevant to all diseases.

4.1.1 Declared premises

Infected premises (IP)

A premises classified as an IP will be a defined area (which may be all or part of a property or a combination of premises/ properties) in which EI or EI virus exists, or is believed to exist. An IP will be subject to quarantine provisions and to eradication and control procedures. See also 3.2.2.

Dangerous contact premises (DCP)

Premises classified as DCPs will be those that, following a risk assessment, are considered highly likely to contain an infected animal or contaminated animal product, waste or thing, and that present an unacceptable risk to the response if that risk is not addressed.

Premises classified as DCPs will include:

- premises containing horses originating from an IP;
- all premises on which horses have been sharing a common fence-line with infected animals on an IP;
- premises containing horses that have been exposed to contaminated products, wastes or things of horses moved from an IP;
- premises with horses that have been handled by personnel immediately after they have handled horses from an IP;
- premises not containing horses (such as knackeries) where there is product associated with an IP held on the premises; and
- all premises where it is considered that disease is highly likely to have spread to horses from an IP by way of the movement of, for example, people and horse transport vehicles, equipment.

Suspect premises (SP)

Premises classified as SPs will be those that contain horses not known to have been exposed to EI virus but showing clinical signs requiring differential diagnosis.

'Suspect premises' is a temporary classification because the premises contains horses that are suspected of having the disease. High priority will be given to clarifying the status of the suspect animals so that the SP can be either reclassified as an IP (and appropriate quarantine and movement controls implemented); continue to be designated as an SP (if the presence of an infected animal is not confirmed but suspicion remains); or, if the presence of an infected animal is ruled out, designated as an ARP (At Risk Premises) (within the restricted area) or POI (Premises of Interest) (within the control area). The premises would continue to be subject to the procedures (such as heightened surveillance) and movement restrictions appropriate to the zone in which the premises is located.

Trace Premises (TP)

'Trace Premises' (TP) is a temporary classification of premises that contain one or more susceptible horses that tracing indicates may have been exposed to an infected horse, or contaminated animal products, wastes or things. Such premises require investigation to clarify the status of the horses.

The investigation may produce the following outcomes:

- if the *case definition* is met, the premises would be designated as an IP;
- if it appears highly likely, as a result of a risk assessment, that the TP contains an infected horse(s) or contaminated products, wastes or things, it would be designated as a DCP;
- if the trace proves to be insignificant, the premises would be designated as an ARP (within the restricted area) or POI (within the control area).

For further information on premises definitions, see <http://www.animalhealthaustralia.com.au/aahc/index.cfm?BDA6CF7D-A00F-3670-2401-D1FA0F0C1421>

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) in order to maintain biosecurity while minimising disruption to normal activities. There may be 2 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, for example that

- 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 for compliance with the measures. Measures will include ability to implement and operate as required check points for entry and exit of horses, 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.

- A 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/work on the premises, that are managed as a unit.

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

4.1.2 Declared areas

Restricted area (RA)

An RA will be a relatively small declared area (compared to a *control area*) around IPs that is subject to intense surveillance and movement controls. The boundaries of an RA should be determined by the anticipated spread of disease based on many factors including horse densities, natural barriers, time of year, anticipated time before vaccination can be implemented around IPs, major roads. Movement out of the area will, in general, be prohibited, while movement within and into the area will only be allowed under permit (see Table 4.2). Multiple RAs may exist within one CA.

The declaration of an RA, which will include all IP(s) and DCP(s) and some or all of the SPs/TPs, assists in preventing spread by restricting movement onto and off the premises that are most likely to have had direct or indirect contact with the IPs. The RA does not need to be circular but can have an irregular perimeter provided the boundary is at least 10 km from the nearest IP or DCP. The boundary could be the perimeter fence of the IP if the IP is in an isolated location. The boundary in a densely populated area will take into account the distribution of susceptible animals, patterns of horse movement, location of high-risk enterprises, and areas that constitute natural barriers to movement.

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

Control area (CA)

The CA will be a larger declared area around the RA(s) and, initially, possibly as large as a state or territory. The declaration of a CA helps to control the spread of the outbreak from the RA. The CA is a buffer zone between the RA and the rest of the industry. The boundary does not have to be circular or parallel to that of the RA but should extend at least 10 kilometres from the boundary of the RA. The boundary of the CA will be adjusted as confidence about the extent of the outbreak increases but must remain consistent with the OIE *Code* recommendations on zoning and compartmentalisation¹⁰ and surveillance¹¹. In general, surveillance and movement controls will be less intense than in the RA, and horses and some products may be permitted to move under permit from the area.

¹⁰ http://www.oie.int/eng/normes/Mcode/en_chapitre_1.4.3.htm

¹¹ http://www.oie.int/eng/normes/Mcode/en_chapitre_1.1.4.htm

In general, the movement of possibly contaminated items and materials within the CA is allowed, but movement out of the CA is prohibited except under permit (see Table 4.2). This type of control area allows reasonable commercial activities to continue.

4.2 Movement controls for equine influenza

4.2.1 Live horses

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 restricted and control areas 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; or
- 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 standstill declaration to follow the above direction. If their situation does not fit one of these scenarios, they should contact their local animal health authorities for directions concerning on-going 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.
- Proceed to original intended destination
 - horses moving to local/regional properties which can be secured to prevent disease spread;
 - horses consigned for slaughter at a knackery.
- Movement to an alternative approved property with no horses or a low density of horses, for example cattle or sheep property, saleyard, 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 specific permit. A permit will be issued only in exceptional circumstances that may include movement due to the unavailability of feed or water, or movement to escape natural disasters such as fire or flood.

Permit conditions for the movement of live horses during the standstill will include:

- Receiving premises of an appropriate biosecurity standard;
- Receiving premises 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 ID.

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 standstill include:

- Probability that the horses are infected and the proposed movement may spread disease
 - higher if horses originate from the infected area/region/jurisdiction;
 - higher if horses originate from premises with a high density of horses; commingle with horses of different origins and frequently move between premises for competition purposes;
 - higher if there has been a change of horse transport vehicle or a stopover during the journey;
 - higher if the consignment is a mixed load.
- Welfare implications
 - prolonged transport times and non-compliance with relevant welfare codes
 - retention of horses in temporary holding facilities at racecourses or other event venues for prolonged periods may compromise 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 e.g. 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, restricted and control areas are being set up but the outbreak is not considered to be under control

To From	RA	CA	outside
RA	prohibited, except under permit: <ul style="list-style-type: none"> • SpP^a - for urgent vet treatment or in case of a welfare emergency • GP^b - for movement into an IA or an infected SPC • GP^c - for movement into a free SPC within the RA 	prohibited	prohibited
CA	prohibited, except under GP ^b	prohibited, except under GP ^b	prohibited
outside	prohibited, except under GP ^b	prohibited, except under GP ^b	allowed under normal jurisdictional arrangements

^a Conditions on specific permits (SpPs) for movement of live horses for urgent veterinary treatment or in case of a welfare emergency

- Movement permitted direct to veterinary hospital (treatment) or to new holding area (welfare);
- Travel by approved route only;
- Appropriate decontamination of equipment and vehicles;
- Individual horse ID.

^b Conditions on general permits (GPs) for movement of live horses into an IA or infected SPC:

- Travel by approved route only;
- Appropriate decontamination of equipment and vehicles on exit from IA or SPC;
- Absence of clinical signs on day of travel;
- Individual horse ID.

^c Conditions on general permits (GPs) for movement of live horses into a free SPC:

- horses have not originated from an IP, DCP, or SP/TP
- single consignment per load;
- for susceptible horses:

- isolation (minimum of 7 days), followed by PEQ¹² (minimum of 14 days) with 2 rounds of testing with PCR, and PAQ (minimum of 7 days)
- for vaccinated horses: either
 - 2 rounds of testing with PCR, and either
 - premises had no introduction of horses for 14 days prior to movement, with isolation of moving horses for final 7 days, or
 - PEQ (minimum of 7 days) and PAQ (minimum of 7 days)
- for recovered horses:
 - PEQ (minimum of 3 days) with positive cELISA, and PAQ (minimum of 3 days)

Notes:

- Movement out of an IA or infected SPC is prohibited
- Movement within an IA or SPC is unrestricted.

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

From \ To	RA	CA	outside
RA	prohibited except under SpP ^c	prohibited except under SpP ^d	as for CA
CA	prohibited except under GP ^e	prohibited except under GP ^f	as for CA
outside	prohibited except under GP ^g	prohibited except under GP ^g	allowed under normal jurisdictional arrangements

Conditions on SpPs for the movement of live horses from:

^c RA to RA

- horses not originating from an IP¹³ or DCP, nor from within 5Km of an IP
- horses not originating from a SP/TP except for urgent veterinary attention or a welfare emergency
- testing of a sample of horses on premises to confirm non-IP status (including testing of all moving horses)
- for susceptible and vaccinated horses: premises had no introduction of horses for 14 days prior to movement
- for recovered horses¹⁴: positive cELISA within 16 weeks prior to movement

¹² PEQ and PAQ to be operated on an all-in-all-out basis

¹³ 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

¹⁴ A recovered horse is one that was infected by the equine influenza virus at least 30 days previously as demonstrated by the presence of a positive cELISA

d RA to CA

- horses have not originated from an IP, DCP, or SP/TP
- single consignment per load;
- for susceptible horses:
 - isolation (minimum of 7 days), followed by PEQ¹⁵ (minimum of 14 days) with 2 rounds of testing with PCR, and PAQ (minimum of 7 days)
- for vaccinated horses: either
 - 2 rounds of testing with PCR, and either
 - premises had no introduction of horses for 14 days prior to movement, with isolation of moving horses for final 7 days, or
 - PEQ (minimum of 7 days) and PAQ (minimum of 7 days)
- for recovered horses:
 - PEQ (minimum of 3 days) with positive cELISA, and PAQ (minimum of 3 days)

Conditions on GPs for the movement of live horses from:

e CA to RA

- horses have not originated from a DCP or SP/TP

f CA to CA, RA to Outside and CA to Outside

- for susceptible and vaccinated horses:
 - isolation (minimum of 7 days), 2 rounds of testing with PCR
- for recovered horses:
 - isolation (minimum of 3 days) with positive cELISA

g outside to RA or CA

- standard permit conditions only

Standard permit conditions for the movement of live horses when RAs and CAs are in operation:

- Receiving premises of an appropriate biosecurity standard;
- Receiving premises 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 ID.

¹⁵ PEQ and PAQ to be operated on an all-in-all-out basis

4.2.2 Declared premises

Table 4.1 shows the movement controls that will apply to things other than live horses on IPs, DCPs and SPs/TPs, in the event of an EI incident.

Table 4.1 Movement controls for declared premises

Quarantine/movement controls	Infected and dangerous contact premises	Suspect/ trace premises
<i>Movement out of:</i>		
- susceptible animals	See 4.2.1.	See 4.2.1
- other live animals	Allowed under general permit.	As for IP/DCP
- specified products	Equine carcasses can be moved under specific 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, knacker trucks, horse equipment etc - prohibited except under specific permit.	As for IP/DCP

Movement in of:

- susceptible animals	Allowed under general permit, for movement into or within a SPC.	As for IP/DCP
- frozen semen and embryos	Allowed under general permit.	As for IP/DCP
- horse feed, hay and straw	Allowed.	As for IP/DCP
- people	Allowed.	As for IP/DCP
- vehicles and equipment	Allowed under general permit, with appropriate biosecurity.	As for IP/DCP

4.2.3 Declared areas

Table 4.2 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 4.2.1.

Table 4.2 Movement controls for declared areas

Quarantine/ movement control	Restricted area (if declared)	Control area (if declared)
<i>Other movements</i>		
- specified products	Equine carcasses can be moved under specific permit to knackeries, but must not be used for pet food unless cooked.	Allowed
- frozen 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, knacker trucks, horse equipment etc - prohibited except under specific permit.	As for RA

Appendix 1 Procedures for surveillance and proof of freedom

Surveillance

For the purposes of this disease strategy, the **initial case definition** of EI is 'a high morbidity rapidly spreading respiratory disease in a group of horses, with laboratory confirmation by 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'.

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 pyrexia horses and from the same horses 2–4 weeks later, or from other convalescent horses.

Disposable gloves should be worn when collecting samples and 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 the RA/s;
- random surveillance by Taqman PCR in the RA(s) sufficient to detect infection with a 95% confidence level at a prevalence of 1% on a premises;
- targeted surveillance by Taqman PCR around recent IPs, DCPs and SPs/TPs;

- serological monitoring of horses by cELISA in the RA and CA (assuming only recombinant vaccine has been used so that sero-positive animals will have been naturally infected); and
- negative EI Taqman PCR or virus isolation from cases of acute equine respiratory disease occurring within any area.

Surveillance strategy during the outbreak

Due to 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; and
3. Visit SPs / TPs in the RA and CA.

Tests for the rapid detection of viral antigen RNA (e.g. Taqman PCR) should be conducted on pyrexial 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 ARPs or POIs 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 POIs 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 of 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.

Proof of freedom

The OIE *Code* states that if an outbreak of clinical equine influenza 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 the EI virus, as well as availability of cELISA or other tests to detect antibodies from natural EI infection, and qPCR to detect any virus or viral antigen. Screening using serological tests can be done in areas not known to have been infected, with horses giving positive results retested by PCR.

Surveillance should take a staged approach with the first stage focusing on demonstrating eradication of EI in isolated disease clusters 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 disease had not infected feral horse populations.

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 infected premises, sero-surveillance can be used on previously infected premises to demonstrate that infection had passed (immunity is present). Investigation of neighbouring properties (PCR testing) can be conducted to ensure that no lateral spread of infection had 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 of infection, surveillance should then be focussed on zones where infection has been 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 that 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 re-zoned allows the mixing of

formerly infected and naive populations of horses, with the latter acting as sentinels for any residual infection.

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Appendix 2 Vaccination supply, strategies and procedures

Vaccine supply

No EI vaccine is manufactured in Australia. While technically feasible, the lead time for manufacture would be many months. During an epidemic initial vaccine requirements will have to be imported. A number of major international companies have subsidiaries or distributors in Australia that could provide a conduit to vaccine access. Comprehensive information about vaccines available internationally and contact details for manufacturers can be found on the EquiFluNet website.¹⁶

One company maintains an AQIS Import Permit and an APVMA Emergency Permit for vaccine for use in horses exported from Australia. However, at the time of writing (2010), this vaccine does not contain an OIE recommended strain of the H3N8 American lineage. It would also be unsuitable for EI control and eradication purposes as it does not have DIVA capability. The H3N8 subtype has shown significant antigenic drift in recent years and, because of the expense and time involved in registering new products, there has been usually a lag in the introduction of updated strains into vaccines. The OIE Expert Surveillance Panel on EI Vaccines (OIE 2008c) reports to the OIE Biological Standards Commission and its recommendations on vaccine strains are published annually in the *OIE Bulletin*.

In 2009, the OIE Panel recommended that EI vaccines should contain an A/eq/South Africa/4/2003 (H3N8)-like virus (American lineage). Other viruses of the American lineage such as A/eq/Wisconsin/03, A/eq/Ohio/03, A/eq/Ibaraki/07 and A/eq/Sydney/07 are as acceptable substitutes for A/eq/South Africa/4/2003. Vaccines that meet the above recommendations are currently commercially available in some countries. 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.

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 experienced in obtaining sufficient quantities internationally, as stockpiles vary throughout the year depending on production runs and local demand.

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

¹⁶ EquiFluNet, the Global Surveillance Network for Equine Influenza hosted by the Animal Health Trust, Newmarket, England. <http://www.equiflunet.org.uk/>

Theoretically, a vaccine bank (on or off shore) or a vaccine supply arrangement could ensure that vaccine stocks are quickly available. Potential problems relating to 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 compared to vaccines produced by newer methodology. There are difficult and complex issues relating to apportionment of the costs associated with development and maintenance of such a strategy and currently (2010) no arrangements are in place. .

Local vaccine manufacture is technically feasible, but Australia has limited manufacturing capability. Planning, including importation of vaccine seed/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 good 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 there is 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 radiofrequency identification device (RFID) 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 as part of existing industry registration programs are not implanted unless the existing RFID 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 website¹⁷ by searching on either microchip number or brands. 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 the Harness Racing Australia by searching on its brand.¹⁸ 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.

Horse numbers, ownership and location

Reliable data on horse numbers and their ownership and location 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 NSW and Qld 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 IPs or as part of surveillance and vaccination operations;
- entries from on-line registration systems for horse properties and horse ownership;
- equine veterinary practitioners;
- information gathered via permit processes for horse movements; and
- ad hoc sources such as telephone directories.

¹⁷ <http://www.studbook.org.au/>

¹⁸ <http://www.harness.org.au/>

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 3.2.4) will be implemented by infected jurisdictions to contain EI with the objective of eradication as part of their Emergency Animal Disease Response Plans. 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 - 1 week for supply of vaccine; 2 weeks to carry out vaccinations if a significant population is to be vaccinated; a 2-4 week inter-vaccination 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. Preventative vaccination in specific compartments of horses to facilitate business continuity (see Section 3.2.4) will be undertaken on a user-pay 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 RA, 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 Customs and to provide cold chain facilities for the distribution of the vaccine to distribution points nominated by the CVOs in each affected jurisdiction.

Distribution points will be required to maintain lockable cold storage which can maintain a temperature range of 2-8°C for storage of the vaccine. Temperature monitors will be required to ensure vaccine does not freeze. Vaccine will be packed in polystyrene coolers with dry ice and temperature monitors in order to ensure cold chain integrity during transport by private veterinarians. Portable refrigeration units may be used in vehicles in some areas.

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 AHA 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, UK, 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 (canary pox vectored) EI vaccine were very infrequent in comparison to the number of horses vaccinated. Transient swelling at 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).

Appendix 3 Features of equine influenza

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Glossary

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.
Specific permit (SpP)	a permit completed jointly by the premises owner / farmer and the relevant government veterinarian or inspector, a printed version of which accompanies the relevant commodity movements. It may impose pre-conditions and/or restrictions on movements.
General permit (GP)	a permit completed via a Web page or some other remote means by the premises owner / farmer or their agent, a printed version of which accompanies the relevant commodity movements. It may impose pre-conditions and/or restrictions on movements. Jurisdictions may assign an appropriate term to <i>GP</i> to suit their legislative system.
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, hooves, bones, fertiliser).
Animal Health Committee	A committee comprising the CVOs of Australia and New Zealand, Australian state and territory CVOs, Animal Health Australia, and a CSIRO representative. The committee provides advice to PIMC on animal health matters, focusing on technical issues and regulatory policy (formerly called the Veterinary Committee). <i>See also</i> Primary Industries Ministerial Council (PIMC)
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Antigenic drift	Occurs within a subtype and involves a series of minor changes, usually point mutations, producing strains each antigenically slightly different from its predecessor.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. <i>See also</i> Chief veterinary officer

AUSVETPLAN	<i>Australian Veterinary Emergency Plan.</i> 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.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. <i>See also</i> Australian Chief Veterinary Officer
Compensation	The sum of money paid by government to an owner for stock that are destroyed and property that is compulsorily destroyed because of an emergency animal disease. <i>See also</i> Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	A committee of state and territory CVOs, representatives of CSIRO Livestock Industries and the relevant industries, and chaired by the Australian CVO. CCEAD convenes and consults when there is an animal disease emergency due to the introduction of an emergency animal disease of livestock, or other serious epizootic of Australian origin.
Control area	A declared area in which the conditions applying 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 outbreak according to need). <i>See</i> Appendix 1 for further details
Cost-sharing arrangements	Arrangements agreed between governments (national and states/territories) and livestock industries for sharing the costs of emergency animal disease responses. <i>See also</i> Compensation, Emergency Animal Disease Response Agreement <i>See also</i> Compensation, Emergency Animal Disease Response Agreement
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises	Premises that contain dangerous contact animals or other serious contacts. <i>See</i> Appendix 1 for further details
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. Types of declared areas include <i>restricted area, control area, infected premises, dangerous contact premises and suspect premises.</i> <i>See</i> Appendix 1 for further details

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 slaughter 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.
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. <i>See also</i> Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include funding mechanisms, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. <i>See also</i> Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. <i>See also</i> Emergency animal disease, Exotic animal disease
Enterprise	<i>See</i> Risk enterprise
Enzyme-linked immunosorbent assay	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen-antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. <i>See also</i> Veterinary investigation

Equidae	Family of herbivorous mammals including horses, asses, donkeys and zebras.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. <i>See also</i> Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	<i>See</i> Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
Haemagglutination inhibition test	A serological test for the presence of antibody in a sample by its ability to inhibit agglutination of red blood cells.
In-contact animals	Animals that have had close contact with infected animals, such as non-infected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of the pathogen into the animal and the first clinical signs of the disease.
Index case	The first or original case of the disease to be diagnosed in a disease outbreak on the index property.
Index property	The property on which the first or original case (index case) in a disease outbreak is found to have occurred.
Infected premises	A defined area (which may be all or part of a property) in which an emergency disease exists, is believed to exist, or in which the infective agent of that emergency disease exists or is believed to exist. An infected premises is subject to quarantine served by notice and to eradication or control procedures. <i>See</i> Appendix 1 for further details
Local disease control centre (LDCC)	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. <i>See also</i> Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.

National management group (NMG)	A group established to direct and coordinate an animal disease emergency. NMGs may include the chief executive officers of the Australian Government and state or territory governments where the emergency occurs, industry representatives, the Australian CVO (and chief medical officer, if applicable) and the chairman of Animal Health Australia.
Native wildlife	See Wild animals
OIE Terrestrial Code	<i>OIE Terrestrial Animal Health Code</i> . Reviewed annually at the OIE meeting in May and published on the internet at: http://www.oie.int/eng/normes/mcode/a_summry.htm
OIE Terrestrial Manual	<i>OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals</i> . Describes standards for laboratory diagnostic tests and the production and control of biological products (principally vaccines). The current edition is published on the internet at: http://www.oie.int/eng/normes/mmanual/a_summry.htm
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Polymerase chain reaction	A method of amplifying and analysing targeted DNA sequences that can be used to detect the presence of viral DNA or RNA.
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.
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.
Primary Industries Ministerial Council (PIMC)	The council of Australian national, state and territory and New Zealand ministers of agriculture that sets Australian and New Zealand agricultural policy (formerly the Agriculture and Resource Management Council of Australia and New Zealand). <i>See also</i> Animal Health Committee
Quarantine	Legal restrictions imposed on a place or a tract of land by the serving of a notice limiting access or egress of specified animals, persons or things.

Rendering	Processing by heat to inactivate infective agents. Rendered material may be used in various products according to particular disease circumstances.
Restricted area	A relatively small declared area (compared to a control area) around an infected premises that is subject to intense surveillance and movement controls. <i>See Appendix 1 for further details</i>
Risk enterprise	A defined livestock or related enterprise, which 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, AI centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots. In the equine industry, risk enterprises include racing complexes, stud farms and equestrian events.
Sensitivity	The proportion of affected individuals in the tested population that are correctly identified as positive by a diagnostic test (true positive rate). <i>See also Specificity</i>
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serological test).
Single radial haemolysis	Test to detect the presence of antibody in serum by radial diffusion and precipitation of antibody or antigen.
Specificity	The proportion of non-affected individuals in the tested population that are correctly identified as negative by a diagnostic test (true negative rate). <i>See also Sensitivity</i>
Stamping out	Disease eradication strategy based on the quarantine and slaughter of all susceptible animals that are infected or exposed to the disease.
State or territory disease control headquarters	The emergency operations centre that directs the disease control operations to be undertaken in that state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent of, 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. <i>or</i> An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises	Temporary classification of premises containing suspect animals. After rapid resolution of the status of the suspect animal(s) contained on it, a suspect premises is reclassified either as an infected premises (and appropriate disease-control measures taken) or as free from disease. <i>See Appendix 1 for further details</i>
Tracing	The process of locating animals, persons or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Vaccination	Inoculation of healthy individuals with weakened or attenuated strains of disease-causing agents to provide protection from disease.
– swamp vaccination	Widespread vaccination of a large proportion of susceptible animals.
– ring vaccination	Vaccination of susceptible animals around a focus of infection to provide a buffer against the spread of disease.
– predictive vaccination	Vaccination targeting enterprises and populations that could be expected to contribute most to future spatial transmission of infection.
Vaccine	Modified strains of disease-causing agents that, when inoculated, stimulate an immune response and provide protection from disease.
– adjuvant	A vaccine in which the vaccine microbe is combined with an <i>adjuvant</i> (a substance known to increase the immunogenicity of the vaccine).
– attenuated	A vaccine prepared from infective or 'live' microbes that have lost their virulence but have retained their ability to induce protective immunity.
– inactivated	A vaccine prepared from a microbe that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from a microbe that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.

Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
–native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
- feral animals	Domestic animals that have become wild (eg cats, horses, pigs).
- exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
Zoning	The process of defining disease-free and infected areas in accord with OIE guidelines, based on geopolitical boundaries and surveillance, in order to facilitate trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

AAHL	Australian Animal Health Laboratory
AGDP	agar gel diffusion precipitation
APVMA	Australian Pesticides and Veterinary Medicines Authority
AQIS	Australian Quarantine and Inspection Service
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
DAFF	Department of Agriculture, Fisheries and Forestry (Australian Government)
DCP	dangerous contact premises
EI	equine influenza
ELISA	enzyme-linked immunosorbent assay
HI	haemagglutination inhibition
IP	infected premises
LDCC	local disease control centre
NMG	national management group
OIE	World Organisation for Animal Health (Office International des Epizooties)
PAQ	post-arrival quarantine
PCR	polymerase chain reaction
RT-PCR	reverse transcription polymerase chain reaction
PEQ	pre-export quarantine
RA	restricted area
SDCHQ	state or territory disease control headquarters
SP	suspect premises
SRH	single radial haemolysis

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Video/training resources

See the **Summary Document** for a full list of training resources.

There are no specific training resources relating to equine influenza.