

AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Disease Strategy

Avian influenza

Version 3.4, 2011

AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incursion. 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 avian influenza (AI) 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 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 poultry industry. It has been endorsed out of session by the Animal Health Committee (AHC OOS 2007).

Avian influenza (AI) is included on the OIE (the World Organisation for Animal Health) list of notifiable diseases. This obliges OIE member countries that had been free from the disease to notify the OIE within 24 hours of confirming the presence of highly pathogenic avian influenza (HPAI) in birds and low pathogenicity avian influenza (LPAI) in poultry (as defined by the OIE). 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 AI 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, HPAI caused by virus of subtypes H5 or H7 is included as a Category 2 emergency animal disease in the *Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses* (EAD Response Agreement).⁴ HPAI caused by a virus of subtype not H5 and H7 and LPAI caused by a virus of subtype H5 or H7 (LPAI (H5/H7)) are included in the EAD Response Agreement as Category 3 diseases.

The detection of active or recent infection with HPAI virus in wild, cage or zoo birds and the detection of active infection with LPAI (H5/H7) virus in cage or zoo birds are addressed, as they would lead to the implementation of arrangements consistent with this manual. This manual also contains a response policy for LPAI (not H5/H7) detections caused by subtypes of AI virus other than H5 and H7 and not classified as HPAI. Responses to the detection of these subtypes are not covered by the EAD Response Agreement.

Where in this manual text has been placed in square brackets [xxx], this 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 are shown below.

¹ These criteria are described in more detail in Chapter 2.1.1 of the *OIE Terrestrial Animal Health Code* (http://www.oie.int/eng/normes/mcode/en_chapitre_2.1.1.htm).

² http://www.oie.int/eng/normes/mcode/en_chapitre_4.5.6.htm

³ http://www.oie.int/eng/normes/mmanual/A_00035.htm

⁴ <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 (to be updated) is a source for some of the information about the aetiology, diagnosis and epidemiology of the disease.

AUSVETPLAN documents⁵

Disease strategies

- Individual strategies for each of 35 diseases
- 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)
- Laboratory preparedness

Summary document

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

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1 Nature of the disease

Avian influenza (AI) is a highly contagious viral infection, primarily in avian species. Clinical manifestations range from inapparent in waterfowl to a rapidly fatal condition characterised by gastrointestinal, respiratory and/or nervous signs in chickens and turkeys.

Recent outbreaks of highly pathogenic avian influenza (HPAI) in eastern Asia have been devastating for local economies (FAO 2004a). In addition, recent changes in the epidemiology of AI virus infections, particularly in the capacity of AI virus to infect humans, have led to a reassessment of the classification and management of such infections.

AI virus infections show a continuous spectrum of pathogenicity in gallinaceous poultry, from no pathogenicity to high pathogenicity (see Section 1.1.2).

From 1955, the disease was known as either 'virulent avian influenza' or 'fowl plague' until an international meeting on AI in 1984 recommended that the name 'highly pathogenic avian influenza' be used to describe the most pathogenic form of infection, as assessed from inoculation of chickens.

This manual considers the consequences that may arise from the infection of poultry with *any* AI virus, and distinguishes between HPAI, low pathogenicity avian influenza (LPAI (H5/H7)) and LPAI (not H5/H7) infections, as defined by the OIE (World Organisation for Animal Health); see Section 1.1.3.

The OIE defines poultry as: 'all domesticated birds, including backyard poultry, used for the production of meat or eggs for consumption, for the production of other commercial products, for restocking supplies of game, or for breeding these categories of birds, as well as fighting cocks used for any purpose.'

1.1 Aetiology and pathogenicity

1.1.1 AI virus classification

All AI viruses are members of the family Orthomyxoviridae. The influenza viruses of this family are categorised into types A, B or C on the basis of the antigenic character of the internal nucleoprotein antigen. Only influenza A viruses have been isolated from avian species.

Influenza A viruses are further divided into subtypes determined by haemagglutinin (H) and neuraminidase (N) antigens. At present, 16 H subtypes and 9 N subtypes have been identified. Each virus has one of each subtype in any combination.

1.1.2 Pathogenicity

The species in the orders Anseriformes (ducks, geese, swans) and Charadriiformes (shorebirds, waders, gulls) are regarded as important reservoir hosts and disseminators of influenza viruses, but rarely display clinical signs of infection. There is extreme variation in virulence among subtypes of AI viruses, and a variety of subtypes is widespread throughout wild aquatic bird populations.

In poultry, HPAI due to H5 and H7 subtypes can cause severe clinical disease, and even subtypes of low pathogenicity, including H5 and H7, can be associated with severe clinical

disease in the presence of other infectious agents (eg infectious bronchitis, infectious laryngotracheitis).

The pathogenicity of AI viruses depends on the genetic properties of the virus and the species of the host. Only viruses with H5 and H7 antigens have been isolated so far from HPAI in poultry. These two subtypes of AI virus are considered to be high-risk strains for antigenic drift towards HPAI, even if the clinical picture seen in poultry is of lesser or no pathogenicity. The cleavability of viral haemagglutinins by proteolytic enzymes also correlates with the virulence of virus strains for chickens (see Section 1.4.2).

LPAI infections of chickens and turkeys with H5 and H7 subtype that have been allowed to continue without adequate control or eradication procedures have ultimately turned into virulent HPAI infections (Pennsylvania, United States, 1982–83; Mexico, 1994; Italy, 1999–2000). The change in virulence of the virus is associated with the acquisition of additional basic amino acids at the cleavage site of the haemagglutinin protein.

In a controlled laboratory environment, HPAI was generated from an LPAI H5 subtype virus, derived from a waterbird, after 24 passages through chickens (Ito et al 2001).

1.1.3 OIE definition of NAI viruses

The OIE has adopted the following criteria for classifying an AI virus as notifiable (OIE Terrestrial Animal Health Code 2007):

- HPNAI viruses that have an intravenous pathogenicity index (IVPI) in 6-week-old chickens greater than 1.2 or, as an alternative, cause at least 75% mortality in 4- to 8-week-old chickens injected intravenously with the virus under investigation.
- Other HPNAI viruses – H5 and H7 viruses that do not have an IVPI of greater than 1.2 or cause less than 75% mortality in an intravenous lethality test should be sequenced to determine whether multiple basic amino acids are present at the cleavage site of the haemagglutinin molecule (HA0); if the amino acid motif is similar to that observed for other HPNAI isolates, the isolate being tested is considered as HPNAI.
- LPNAI viruses – all influenza A viruses of H5 and H7 subtype that are not HPNAI viruses.

LPAI viruses (not notifiable to the OIE) are influenza A viruses of subtypes other than H5 and H7 and that are not HPNAI viruses.

The above OIE definitions are used in this manual.

The tests required to meet these OIE criteria are described in Section 1.4.4. However, the IVPI and chicken mortality tests have the disadvantage of being slow to perform. Genotyping of the haemagglutinin cleavage site is faster and more precise and is the test of choice in Australia.

Molecular pathotyping, as well as subtyping (see Section 1.4.4), is needed for all AI viruses isolated, to determine the likelihood of an H5 or H7 virus mutating to a virulent form.

For the purposes of international trade, the AI chapter in the OIE Terrestrial Code deals not only with the occurrence of clinical signs caused by notifiable AI (NAI) virus, but also with the presence of infection with NAI virus in the absence of clinical signs. NAI virus infection occurs when:

- HPNAI or LPNAI virus has been isolated and identified as such;

- viral antigen or viral RNA specific to HPNAI or LPNAI has been identified; or
- antibodies to H5 or H7 subtype of NAI virus that are not a result of vaccination have been detected in poultry.

1.1.4 Australian emergency animal disease classification of AI

Outbreak of HPAI

An outbreak of HPAI in poultry in Australia is defined as:

- clinical disease in poultry, with an influenza virus that meets the OIE criterion for lethality to 4- to 8-week-old chicks (where such a virus will probably, but not necessarily, be of H5 or H7 subtype); or
- clinical disease in poultry, with an influenza virus that meets the other OIE criteria for HPNAI (ie H5 or H7 subtype and has basic amino acid sequences at the haemagglutinin cleavage site that are close to those observed in HPAI isolates).

In these cases, the AI virus involved would meet the OIE definition of HPNAI (see Section 1.1.3). An emergency disease outbreak would be declared under the terms of the *Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses* (EAD Response Agreement), and control measures would be initiated to protect animal and public health. HPAI (H5/H7) is a Category 2 emergency animal disease (EAD) and HPAI (not H5/H7) is a Category 3 EAD (see Section 3.4).

Outbreak of LPAI (H5/H7)

An outbreak of LPAI (H5/H7) in poultry in Australia is defined as:

- infection in poultry, with or without clinical signs, with AI virus that is an H5 or H7 subtype that is not defined as HPNAI under the OIE criteria (see Section 1.1.3).

In this case (LPAI (H5/H7)), the virus does not have an amino acid sequence that is similar to that observed for HPAI isolates. However, action to control the spread of infection is necessary, particularly if the virus is highly transmissible and is spreading in poultry, since it is likely that the virus will mutate and become highly pathogenic for chickens.

LPAI (H5/H7) is a Category 3 EAD under the EAD Response Agreement (see Section 3.4).

Detection of HPAI and LPAI (H5/H7) virus in cage or zoo birds

Cage birds are defined as birds that are confined within an enclosure and maintained for purposes other than food production. Zoo birds are cage birds that are maintained at a zoo premises.

The detection of active or recent infection with HPAI virus in cage or zoo birds would lead to an emergency disease outbreak being declared under the terms of the EAD Response Agreement. However, the detection of HPAI or LPAI in cage or zoo birds has not been categorised under the EAD Response Agreement with regard to cost sharing. The action to be taken following the detection of active infection with LPAI (H5/H7) virus in cage or zoo birds would be determined after an assessment of the situation.

Detection of HPAI in wild birds

The detection of HPAI in wild birds (free flying birds not under any control or ownership) is defined as the isolation and typing of an HPAI virus or the detection of genetic material from an HPAI virus. Sero-evidence of H5 or H7 antibodies is not considered to be evidence of HPAI infection.

Other detections of AI virus infections

Other detections of AI that may also have importance for the poultry industry in Australia are defined as LPAI (not H5/H7) – any other AI virus detected in poultry that is not classified as HPAI or LPAI (H5/H7), as defined above.

1.2 Susceptible species

AI virus is infective for almost all commercial, domestic and wild avian species. Infections in monkeys, pigs, ferrets, horses, cattle, cats, seals and whales have been reported. The significance of nonavian species in spreading HPAI viruses is not well understood, but their role appears to be minimal.

Chickens and turkeys

Chickens and turkeys are highly susceptible to infection and clinical disease.

Ducks and geese

Ducks and geese are susceptible to infection with all AI virus strains, but only some very virulent viruses produce clinical disease. AI virus is commonly isolated from these species in endemic areas. Their potential as reservoir hosts is considered to make waterfowl a major source of virus for poultry. In 2004, subtype H5N1 caused widespread deaths in ducks, geese and chickens in China (WHO 2004a). Previously, deaths were recorded in waterbirds in Hong Kong in 2002. There were reports of limited mortalities in ducks and geese in Italy (Capua and Mutinelli 2001, Sturm-Ramirez et al 2004).

Guinea fowl, quails, pheasants and partridges

Guinea fowl, quail, pheasant and partridge are susceptible to infection and clinical disease. Quail have presented special challenges for control in HPAI and LPAI outbreaks in Italy, in that infection appears to spread slowly in them; surveillance programs by serology and virus isolation therefore require higher levels of testing than for chickens to detect infection (I Capua, OIE and National Reference Laboratory for Avian Influenza, Italy, pers comm).

Emus, ostriches and rheas

AI virus subtypes H5N2 and H7N1 have been isolated from emus and rheas in the United States, demonstrating their susceptibility to infection, and from emus in the 1997 outbreak in New South Wales. However, AI virus was not confirmed as the cause of disease or death in either the United States (Panigrahy et al 1995) or Australia.

Outbreaks of HPAI due to a highly pathogenic H5N2 subtype virus have occurred in ostriches in South Africa in the past few years.

AI has also been associated with a syndrome characterised by respiratory signs, enteritis, weakness and death of ostriches in South Africa (Allwright et al 1993) and in Denmark

(Jorgensen et al 1998). An outbreak with over 20% mortality was reported to the OIE in April 1994. In Italy in 2000, young ostriches suffered 30% mortality when infected with H7N1 virus during an HPAI outbreak (Capua et al 2000a). An AI virus that was virulent for chickens was isolated from an emu in Texas, United States, in 1993. This virus did not cause clinical signs of HPAI when inoculated into ostriches, but was isolated widely from internal organs (Clavijo et al 2001).

Caged birds, including psittacines and canaries

The AI viruses isolated worldwide from captured wild and exotic birds have not been isolated from caged birds.

Wild aquatic birds

The huge pool of viruses in wild birds, especially waterfowl, in which the virus replicates in the intestine, provides an opportunity for new combinations of H and N subtype viruses to arise through genetic re-assortment. In the waterfowl reservoir host, AI viruses usually remain LPAI for poultry; sequences of the H1 gene from wild waterfowl in 1917 are remarkably similar to modern avian H1 gene sequences, suggesting little drift over 80 years (Reid et al 2003). Infection in wild bird populations with HPAI strains has generally been limited and self limiting.

Field surveys have suggested that many species of waterfowl, particularly ducks, geese and swans, are the natural hosts of AI viruses. AI viruses have also been recovered from gulls, terns and shearwaters. Intensive surveillance of wild birds during the 1983–84 AI outbreak in Pennsylvania, United States, confirmed that aquatic birds harbour many influenza viruses. Subsequent reports on the prevalence of AI infection in waterfowl range from 0.6% to 26% (Alfonso et al 1995). Crows have become infected with and died from H5N1 subtype virus infection in Japan (ProMED 2004a).

AI viruses of many H and N subtypes have been isolated from, or demonstrated in, a wide range of wild waterbirds, including migratory species in well-separated locations throughout Australia. Thus, a virus that is virulent for poultry could emerge from the pool of viruses in wild birds at any time, particularly AI viruses of subtypes H5 and H7. Representatives of H1, H3, H4, H5, H6, H11, H12 and H15 AI viruses have been isolated from wild aquatic birds in Australia (Arzey 2004). The source of virus in outbreaks of H7 AI viruses in Australia is not known, as there have been no reports of the isolation of H7 AI viruses from wild birds in Australia (Cross 1987, Peroulis and Arzey 2004, O’Riley 2004, C Morrow, Victorian Institute of Animal Science, pers comm, 1996).

Wild birds other than waterfowl

Crows have become infected with and died from H5N1 subtype virus infection in Japan (ProMED 2004a).

Mammals

Human volunteers inoculated with a number of H subtypes of AI viruses (not H5 or H7) showed mild disease but did not produce an antibody response (Beare and Webster 1991). There was no field evidence that avian-derived viruses infected humans until the Hong Kong incident of 1997. Since then, more infections with H5N1 viruses have been recorded in Hong Kong, and in Vietnam and Thailand in 2004 and 2005 when more than half of those infected died. In the Netherlands in 2003, 89 people became infected with H7N7 virus, with a veterinarian dying, and Hong Kong and China have recorded human infections with

H9N2 virus (Peiris et al 1999, Lin et al 2000). Canada recorded human infections with H7N3 subtype virus. A serological survey of poultry workers in Hong Kong found that 17% had antibody without known clinical signs of infection with H5N1.

Human infections have usually required direct contact with infected poultry, although a small number of relatives in contact with infected workers during the Netherlands H7N7 outbreak became infected (3 of 83 tested; Koopmans et al 2004). A retrospective study in the Netherlands has suggested that an estimated 1000 people, possibly more, became infected with the H7N7 virus. The serological study showed that about 50% of people who handled infected poultry became infected, and antibody was detected in 59% of the members of infected poultry workers' families, indicating much more human-to-human transmission than supposed in the initial study (ProMED 2004b). The antiviral drug *oseltamivir* protected against infection, but mouth and nose masks did not provide protection. In southern China, a small number of influenza cases have been associated with infection from H9N2. Human-to-human spread of H5N1 AI virus was recorded in Hong Kong (Katz et al 1999, Bridges et al 2000, Katz 2003).

Infection of pigs with H7N7 subtype was evidenced by detection of antibody in the sera of pigs during the Netherlands outbreak in 2003 (ProMED 2003); herds with positive serology rates above 2.6% were slaughtered. Reports of infection in pigs with H5N1 subtype in Asia have been confirmed (ProMED 2004c).

A snow leopard and a white tiger were reported to have died with HPAI infection in a Thai zoo, and three domestic cats were reported as having died with H5N1 infection in Thailand in 2004. A large number of tigers became infected with H5N1 virus following the feeding of infected carcasses in Thailand (ProMED 2004a). Inoculated cats and cats fed infected chicken meat became infected with H5N1 virus and died with severe alveolar disease; in-contact cats also acquired infection (Kuiken et al 2004).

1.3 World distribution and occurrence in Australia

AI virus occurs, in one or a number of its many serotypes, in all continents where research has been carried out. It appears to be endemic in waterfowl, in which it does not often cause disease (see Section 1.2). Migratory birds are considered to be one of the means by which the disease travels across and between continents (Easterday and Beard 1984).

Internationally, 12 outbreaks of HPAI were recorded to 1994 following the recognition in 1955 that fowl plague, or HPAI, was caused by an influenza virus; since 1994, there have been 25 further outbreaks, most of which occurred from 2000 onwards.

The last two large outbreaks of HPAI in North America (Mexico 1995 and United States 1983), the 1999 outbreak in Italy, and outbreaks in the Netherlands, Chile, Canada and Australia all initially involved LPAI. In each case the AI infection became widespread and HPAI virus emerged by mutation, after which decisive depopulation had to be undertaken.

In Italy, LPAI infection was detected in the summer of 1999. By late in 1999, HPAI virus had emerged and 13 million poultry died of HPAI infection in four months; HPAI was eradicated in April 2000. In August 2000, viruses of lesser pathogenicity reappeared in meat turkeys and rapidly spread in an area of high poultry density (Capua et al 2000b). This outbreak was eradicated using vaccination with the other control measures (Capua and Marangon 2003).

Since December 2003, there have been outbreaks of highly pathogenic H5N1 AI in poultry and other birds in Korea, Japan, Vietnam, Thailand, Cambodia, Laos, Myanmar, Indonesia, China and Malaysia. In 2005, H5N1 was reported in birds in Kazakhstan, Mongolia and Russia, and the disease then spread westwards into Romania, Turkey and the Ukraine. Since early 2006, there have been reports of H5N1 virus in wild and domestic birds in some European Union Member States, domestic birds in India, and in domestic and wild birds in the Middle East (Iraq, Iran and Israel). The virus has also been reported in domestic birds in some countries in Africa (Niger, Nigeria, Egypt, the Ivory Coast and Cameroon), and in Afghanistan.

For the latest information on the distribution of avian influenza, refer to the OIE website.⁶

The five outbreaks of AI that occurred in Australia between 1976 and 1997 all involved HPAI viruses, and this has made decisions on dealing with the infections clear cut. HPAI viruses caused clinical disease in commercial poultry in Victoria in 1976, 1985 and 1992, in Queensland in 1994, and in New South Wales in 1997. Each time, there was severe disease in affected chicken flocks and all had obvious or circumstantial evidence of contact with waterfowl. All the Australian outbreaks to date have involved H7 subtype viruses. However, there is some evidence that, initially, LPAI may have been involved in the 1976 outbreak (Westbury 1998), the 1992 Victorian outbreak (Victorian Department of Agriculture records) and the 1997 outbreak (Selleck et al 2003).

1.4 Diagnostic criteria

For terms not defined in the text, see the Glossary.

[In future, this Section will also address the diagnosis of AI in birds other than poultry.]

1.4.1 Clinical signs

The clinical signs of AI infection are variable and influenced greatly by the virulence of the viruses involved, the species affected, age, concurrent bacterial disease and the environment. Pathogenicity in chickens can vary during an outbreak.

Infection with viruses of low pathogenicity for chickens (LPAI)

- Clinical signs in chickens and turkeys range from inapparent to mild or severe respiratory disease and can be confused with infectious laryngotracheitis and other respiratory tract infections.
- Mortality ranges from 3% in caged layers to 15% in meat chickens; high mortalities to 90% have been recorded in young turkey poults.
- Egg production in layers can drop by up to 45%, with recovery to normal in 2–4 weeks.
- Mutation to virulence has been demonstrated with H5 and H7 virus subtypes in outbreaks in the United States, Mexico and Italy. In the Netherlands, LPAI (H5/H7) viruses in waterfowl in 2002 became re-assorted and became an HPAI outbreak the following year in domestic galliforms. The mutation to virulence probably occurred in one shed on the index farm.

⁶ http://www.oie.int/download/AVIAN%20INFLUENZA/A_AI-Asia.htm

Infection with viruses highly pathogenic for chickens (HPAI)

- Clinical signs in chickens and turkeys include severe respiratory signs with excessively watery eyes and sinusitis, cyanosis of the combs, wattle and shanks, oedema of the head, ruffled feathers, diarrhoea and nervous signs (see Section 1.4.3 for further details).
- The last eggs laid after the onset of illness frequently have no shells.
- In peracute cases involving sudden death, clinical signs may not be seen and mortalities occur as early as 24 hours after the first signs of the disease, and frequently within 48 hours. In other cases, more diverse visible signs are seen, and mortalities can be delayed for as long as a week. Overall mortality rates for peracute/acute cases of nearly 100% have been reported. Chickens in cages may have a prolonged incubation period of up to 16 days, as evidenced in Italy in 1999–2000 (I Capua, OIE and National Reference Laboratory for Avian Influenza, Italy, pers comm).
- Some severely affected hens may recover, but rarely come back into lay.

The disease in turkeys is similar to that seen in chickens, but is often complicated by secondary infections such as fowl cholera, turkey coryza and colibacillosis.

1.4.2 Pathogenesis

Most HPAI viruses isolated from poultry have come from chickens and turkeys. Clinical signs result from the replication of the virus in the respiratory tract and subsequent systemic replication in the visceral organs and brain. The viruses that are nonpathogenic replicate only on the surfaces of the respiratory and intestinal tracts.

The major determinant of virulence of AI viruses is the cleavability of the H protein. If the H cleavage site has the right configuration of basic amino acids, the protease enzymes found in internal organs are able to cleave the protein resulting in a higher likelihood of systemic spread. Without this configuration, however, the protein can only be cleaved by trypsin-like enzymes, which have a more restricted distribution on endodermal surfaces, such as the respiratory and intestinal tracts (Swayne and Suarez 2000). Non-highly pathogenic viruses cannot produce plaques in cell cultures unless trypsin is added to the substrate medium.

Molecular pathotyping should be performed on AI viruses of all subtypes isolated from poultry and wild birds to ascertain their potential to develop virulence by mutation.

1.4.3 Pathology

Gross lesions

In many cases, poultry dying from the peracute form of the disease lack visible gross lesions; such chickens die on day 1 or day 2 after infection. With the acute infections seen in chickens in Hong Kong and Italy in 1997, there was severe lung congestion, haemorrhage and oedema in dead chickens; other organs and tissues appeared normal.

With the acute form of infection, seen 3–5 days after inoculation, more diverse visible lesions are evident. Chickens have ruffled feathers, congestion and/or cyanosis of the comb and wattles, and swollen heads. The changes in the comb and wattles progress to dark red, then to blue depressed areas of ischaemic necrosis. Internally, the characteristics of acute infections with viruses causing HPAI are haemorrhagic, necrotic, congestive and transudative changes. The oviducts and intestines often have severe haemorrhagic changes.

As the disease progresses, the pancreas, liver, spleen, kidney and lungs can display yellowish necrotic foci.

Haemorrhages (petechial and ecchymotic) cover the abdominal fat, serosal surfaces and peritoneum. The peritoneal cavity is frequently filled with yolk from ruptured ova, associated with severe inflammation of the air sacs and peritoneum in birds that survive 7–10 days. Haemorrhages may be present in the proventriculus, particularly at the junction with the gizzard (Swayne and Suarez 2000).

In infections such as mildly pathogenic AI, lesions may be seen in the sinuses, characterised by catarrhal, serofibrinous, mucopurulent or caseous inflammation. The tracheal mucosa may be oedematous with an exudate varying from serous to caseous. The air sacs may be thickened and have a fibrinous to caseous exudate. Catarrhal to fibrinous peritonitis and egg yolk peritonitis may be seen. Catarrhal to fibrinous enteritis may be seen in the caeca and/or intestine, particularly in turkeys. Exudates may be seen in the oviducts of laying birds (Easterday et al 1997).

Microscopic lesions (histopathology)

The histopathological lesions seen in the gross changes described above are not definitive for HPAI, although vasculitis in the brain and other organs may be highly suggestive of the disease.

1.4.4 Laboratory tests

As pathological changes are not definitive for the disease, diagnosis needs to be confirmed by the isolation and characterisation of the causative virus. Bacteriology should be performed to exclude bacterial septicaemias from the differential diagnosis, particularly to identify mixed infections with lesser pathogenic forms of AI.

Specimens should initially be sent to the state or territory diagnostic laboratory, from where they will be forwarded in packaging that complies with International Air Transport Association requirements 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.

Specimens required

Samples should be taken both from live, clinically affected birds and from recently dead birds. Cloacal and tracheal swabs and/or fresh faeces and serum should be taken from live birds. From dead birds, alimentary tract tissues (proventriculus, pancreas, intestine, caecal tonsil) and respiratory tract tissues (trachea, lung) should be collected. For details of sample collection, transport, storage and processing, see Geering et al (1995) and the **Laboratory Preparedness Manual**.

Transport of specimens

Fresh tissues and/or swab samples in transport medium need to be chilled and forwarded with frozen gel packs (Geering et al 1995).

Laboratory diagnosis

Tests currently available at CSIRO-AAHL are shown in Table 1.1.

Tests for virus subtype

Influenza viruses can be typed as either A, B or C, but all AI viruses isolated from poultry have been type A. Avian influenza viruses are further subtyped on the basis of their H and N antigens. There are 16 different H subtypes and 9 N subtypes, with all combinations possible. So far, highly pathogenic viruses for poultry have all been identified as H5 or H7 haemagglutinin subtypes.

Table 1.1 Diagnostic tests currently available at CSIRO-AAHL for avian influenza

Test	Specimen required	Test detects	Time taken to obtain result
Immunofluorescence	Fresh tissue (including pancreas)	Viral antigen	4 hours
Immunohistochemistry	Formalin-fixed tissues	Viral antigen	2 days
Virus isolation	Tissues Tracheal swabs Cloacal swabs	Virus	2–10 days
Virus identification by HI, EM/immune EM, neuraminidase inhibition test	Virus isolate	Specific N antigens Specific H antigens Influenza A antigen	4 days 1 day 1 day
Serology on flocks and surrounding flocks: HI subtype specific, ELISA/AGDP group specific, neuraminidase inhibition test	Serum	Antibody	1 day
Pathogenicity tests: bird challenge	Virus isolate	Pathogen and pathogenicity of virus	2–10 days
PCR/gene sequencing	Virus isolate Genetic material	Virulence markers (pathotyping)	2–3 days
Real-time PCR	Ttracheal swabs Cloacal swabs Tissues	Type A influenza, H5 subtype viruses (Southeast Asian H5 viruses) and H7 subtype viruses (Australian)	<1 day

AGDP = agar gel diffusion precipitin test; ELISA = enzyme-linked immunosorbent assay; EM = electron microscopy; HI = haemagglutination inhibition; PCR = polymerase chain reaction
Source: Information provided by CSIRO-AAHL, 2004 (refer to CSIRO-AAHL for most up-to-date information).

Tests for pathogenicity

The pathogenicity of an influenza virus isolated from a bird can be determined by one or more of the following tests (Swayne and Suarez 2000; see also the OIE definition of pathogenicity in Section 1.1.3).

- *Chicken pathogenicity tests.* A solution of virus in bacteria-free allantoic fluid is inoculated intravenously into eight 4–8-week-old specific pathogen free chickens. If six or more chickens die within 10 days, the virus is considered to be highly pathogenic for chickens (HPAI virus).
- *Cell culture tests.* Virus is added to cell cultures in the presence or absence of trypsin. If plaques form in the absence of trypsin and the isolate kills 1–5 chicks in the chicken pathogenicity test, the virus can be considered to be highly pathogenic for chickens.

- *Molecular pathotyping.* The gene encoding the haemagglutinin protein of the virus at the cleavage site is sequenced. There are well-recognised differences between the gene sequences of highly pathogenic and lesser pathogenic viruses.

Because time is of the essence for diagnosis, molecular pathotyping is the preferred method of determining the pathogenicity of an AI virus in Australia. Once an outbreak virus has been characterised, immunohistochemistry, immunofluorescence, virus detection and virus isolation can be used to confirm virulent infections.

The Texas, United States outbreak virus was reported as having basic amino acids at the cleavage site consistent with other HPAI viruses, but it was later reported as having no pathogenicity by the chicken pathogenicity test (OIE 2004a). Canada similarly reported a probable H7 infection detected by surveillance as HPAI and subsequently reported that the virus was nonpathogenic by the chicken pathogenicity test, but the virus from a separate site later proved to be fully HPAI (OIE 2004b).

Tests for previous infection

Evidence of previous AI infection can be obtained by testing for influenza A group specific antibody using an agar gel diffusion precipitin test or enzyme-linked immunosorbent assay (ELISA), or by testing for subtype-specific antibody to the H or N antigens using a haemagglutination inhibition test or ELISA, respectively.

1.4.5 Field tests

The Directigen™ test, which tests for influenza group A antigen and was developed as a rapid test for human influenza detection, has been used in outbreaks as a rapid field diagnostic test, although the test has not been validated for the purpose in poultry. Real-time polymerase chain reaction (PCR) has been used for the rapid detection of H5 and H7 HPAI viruses in Hong Kong (Sims et al 2003) and in Pennsylvania and Virginia in the United States (Akey 2003, Lu et al 2004). There has been a comparison of three rapid-detection systems for AI virus in tracheal swabs of experimentally and naturally infected birds (Cattoli et al 2004). The PCR tests appeared to have a higher sensitivity than the Directigen™ test. Veterinary diagnostic laboratories in the states and territories now have the capacity to conduct real-time PCR testing for avian influenza.

1.4.6 Differential diagnosis

Avian influenza and Newcastle disease of chickens and turkeys with various levels of pathogenicity are frequently indistinguishable on clinical and postmortem examination from:

- mycoplasmosis;
- fowl cholera;
- *Escherichia coli* cellulitis of the head;
- acute pasteurellosis;
- infectious laryngotracheitis;
- infectious coryza;
- avian chlamydiosis
- acute poisoning; or
- misadventure causing high mortality (eg smothering, heat stress, dehydration).

HPAI should be suspected whenever sudden bird deaths occur with severe depression, loss of appetite, nervous signs, watery diarrhoea, severe respiratory signs and/or a drastic drop in egg production, with production of abnormal eggs. The likelihood of AI is increased by the presence of facial subcutaneous oedema, swollen and cyanotic combs and wattles, and petechial haemorrhages on the internal membrane surfaces.

Young chickens, or those dying from the peracute form of the disease, may not show any lesions.

1.5 Resistance and immunity

[In future, this Section will also address the vaccination of birds other than poultry.]

1.5.1 Innate and passive immunity

Waterfowl and many other species of wild birds are innately resistant to disease but not to infection. However, H5N1 subtype viruses that are pathogenic in chickens have become pathogenic for waterbirds and domestic ducks in China (Sturm-Ramirez et al 2004) and for crows in Japan (ProMED 2004a).

1.5.2 Active immunity

Immunity following infection with a virus of the same H subtype persists for varying lengths of time. The United States government control programs during the 1983–84 outbreak in Pennsylvania demonstrated that some flocks that had seroconverted but were not showing clinical signs of AI were generally seronegative six weeks after they were assumed to have been infected. However, other infected flocks that recovered were seropositive for up to a year later, although virus could not be isolated.

Other work has demonstrated that birds infected with nonpathogenic viruses were protected against challenge with virulent strains having similar surface antigens.

1.5.3 Vaccination

Human and animal AI vaccines are under development and assessment, as overseas there have been human infections with H5 and H7 AI virus, and human deaths associated with H5N1 virus. While new technologies will influence poultry vaccines in the future, at present the types of vaccine licensed by overseas authorities for use in poultry include:

- inactivated whole AI virus vaccines;
- live genetically modified vaccines including fowl pox and Newcastle disease virus vectored vaccines; and
- inactivated genetically modified vaccines.

Table 1.2 gives examples of the use of vaccines in recent overseas outbreaks of avian influenza.

Australia has set up an expert group to monitor international developments in vaccine policy and technology.

Many vaccines used recently around the world are inactivated whole AI virus antigen in an oil-based emulsion adjuvant, produced according to OIE standards. Inactivated vaccines

are made by formalin treatment of infected allantoic fluids from chicken embryos and adjuvanted by making a water-in-oil emulsion using mineral oil. Immunity results primarily from response to the H protein and, to a lesser degree, the N antigen. These vaccine technologies produce safe, pure and potent vaccines, and commercial inactivated vaccines have been shown to protect against disease and prevent mortality. However, they require the handling and injection of individual birds. A second disadvantage is that they are not able to prevent virus shedding in chickens challenged with antigenically different viruses. This may aid virus persistence in the field and demonstrates the need for regular review of vaccine viruses for their antigenic relatedness to field strains.

Table 1.2 Examples of the use of vaccines in recent overseas outbreaks of avian influenza

Country/date	Avian influenza infection	Vaccine
United States, 1970–now	Preventive measure (turkeys)	Various trivalent inactivated vaccines used to cover predominant subtypes
United States, 1994–2003	LPAI H6N2, H7N2 LPAI H7N3 (turkeys)	Inactivated vaccines
Italy, 1994–2004	H7N1, H7N3, H5N2	Inactivated vaccine
Mexico, 1995–2001	LPAI H5N2	Inactivated vaccines
Pakistan, 1995–now	HPAI/LPAI H7N3	Inactivated vaccine
Mexico, El Salvador, Guatemala, 1997–2003	LPAI H5N2	Recombinant fowl pox virus vaccine
Hong Kong, 2002–04	HPAI H5N1	Inactivated vaccine
Netherlands, 2003	HPAI H7N7	Inactivated vaccine (high-risk birds)
China, 2003–now	HPAI H5N1	Inactivated and genetically modified vaccines
Indonesia, 2004–now	HPAI H5N1	Inactivated vaccine
Vietnam, 2004–now	HPAI H5N1	Inactivated vaccine

HPAI = highly pathogenic avian influenza; LPAI = low pathogenicity avian influenza

The inactivated vaccines use homologous H determinants (eg H5) and either a homologous or heterologous N determinant to provide protection against known current field strains of AI virus. The use of heterologous N subtype vaccines provides an opportunity to use serological surveillance to detect circulating field virus by detecting antibodies to the N subtype of the field virus, in what is known as a differentiating infected from vaccinated animals (DIVA) strategy. Vaccine technologies are being developed which will enable DIVA testing based on viral proteins other than the N antigen, obviating the need for using heterologous N subtypes for DIVA purposes.

Possible problems with the use of vaccines include:

- inactivated vaccines could produce antigenic drift in field viruses;
- vaccination may favour the emergence of more virulent variants;
- possible masking of low levels of circulating field virus; and
- decrease in efficacy when used for a long period.

Inactivated whole virus vaccines which may be appropriate for use in Australia during an emergency have been identified and are undergoing regulatory assessment. Following importation, they would be held in quarantine until vaccination is authorised by the

Consultative Committee on Emergency Animal Diseases (CCEAD). Use of a vaccine will be under the control of the CVOs.

Effective vaccination reduces susceptibility to infection and, where infection does occur, reduces the amount of virus shed into the environment. These two factors mean that, under some circumstances, vaccination may provide valuable assistance in eradication programs. Vaccination may be considered to assist in managing particular compartments of birds considered to be at risk of infection such as captive endangered species; the cost-sharing agreement may not apply in some of these circumstances.

1.6 Epidemiology

AI viruses are not very resistant to warm temperatures, but they remain viable for longer periods in cold and humid environments (see Section 1.6.2); as a consequence, the number of outbreaks in Italy increased with the onset of winter (Capua and Marangon 2000). It was noted in these outbreaks that the circulation of AI viruses of varying pathogenicity complicated the interpretation of diagnostic results, leading to delays in initiating eradication procedures for HPAI. Similar events were recorded in the outbreaks in Pennsylvania, United States in 1983–84 (Webster and Kawaoka 1988).

1.6.1 Incubation period

Incubation periods are extremely variable for HPAI, from a few hours to 2–3 days. The OIE Terrestrial Code gives a maximum incubation period, for regulatory purposes, of 21 days. The less virulent strains have a very variable incubation period, but their transmissibility should ensure that many sick birds will be seen in the early stages of an outbreak. An incubation period extending to 16 days, for both LPAI and HPAI, has been recorded in Italy for layers in cages, and virus spreads very slowly in quail (I Capua, OIE and National Reference Laboratory for Avian Influenza, Italy, pers comm).

1.6.2 Persistence of virus

General properties/environment

Environmental conditions have a marked effect on virus survival outside the bird. Survival is prolonged in aerosols by high relative humidity and low temperature, and low temperature and high moisture levels prolong survival in faeces.

AI virus can survive in faeces for at least 35 days at 4°C, and survival of virus in dust in poultry houses has been reported for two weeks after depopulation. AI virus can survive within the poultry house environment for up to five weeks (Webster et al 1978).

The virus is stable over a pH range of 5.5–8.

AI virus can be isolated from lake water where waterfowl are present (Hinshaw et al 1979). Virus may remain infective in lake water for up to four days at 22°C and for over 30 days at 0°C (Webster et al 1978).

The presence of lipid in the AI virus envelope makes the virus highly susceptible to disinfectants, including detergents (but only if items have been properly cleaned before they are disinfected; see Section 2.2.10).

Wild birds

As indicated in Section 1.2, AI virus is infective for almost all wild avian species, which form an important reservoir for the virus. A virus that is highly pathogenic for poultry could emerge from the pool of viruses in wild birds at any time.

Waterfowl

Wild aquatic birds, such as waterfowl and seabirds, are important reservoirs and can shed AI virus for up to one month, compared with two weeks in domestic species.

AI virus from waterfowl can remain viable in faeces and water for up to 32 days.

During the 2003 Netherlands outbreak, 85 samples from waterfowl yielded seven H7N7 viruses – four were from ducks and three were from mute swans. This infection rate would be similar to the rate of isolation recorded by random sampling when there is no outbreak.

China has reported heavy mortalities in domestic ducks, geese and chickens from H5N1 virus infection in 2004; the acquisition of pathogenicity for waterfowl is a significant change in the virus, indicating mutations (WHO 2004a).

Wild birds other than waterfowl

AI virus has been recovered from autolysed carcasses of wild birds (other than waterfowl) after 23 days at 4°C. The virus has been isolated from captured exotic species, but the duration of virus excretion is not known.

Crows were reported dead in the repeated outbreaks in Japan (ProMED 2004a).

Game birds

AI virus was recovered from pheasants, partridges and guinea fowl for up to seven days after infection during the outbreak in the United States in 1983–84.

In the Italian HPAI and LPAI outbreaks, quail showed few clinical signs and did not always produce an antibody response to infection, and infection spread slowly – all of which made detection of infection less straightforward (I Capua, OIE and National Reference Laboratory for Avian Influenza, Italy, pers comm).

Caged birds, including psittacines and canaries

AI viruses isolated from wild birds have not yet been isolated from caged birds.

Live poultry

Viruses with the potential to be highly pathogenic for chickens and turkeys can be carried by birds and shed in faeces and from the respiratory tract for at least two weeks and up to 30 days after recovery from the disease, while the virulent viruses can be carried by other avian species without signs of clinical disease (Webster et al 1978). The importance of spread by live poultry became apparent in the 2004 eastern Asia epidemic.

Cloacal shedding can continue for longer than 30 days after infection in the presence of immunosuppressive diseases or other physical stresses.

Backyard poultry were extensively surveyed in the Netherlands outbreak of H7N7 subtype; the eradication program depopulated about 150 000 pet birds on about 15 000 premises, and infection was detected by virus isolation retrospectively on 14 sites and by serology on eight sites.

Mammals

As indicated in Section 1.2, AI viruses can replicate in mammals and have been recovered from experimentally infected pigs, ferrets and cats for several days after infection.

Carcases

AI virus survives for several days in carcasses at ambient temperatures, compared with a few weeks at refrigeration temperatures (Easterday et al 1997). There are insufficient data on the spread of virus from fresh, frozen and processed meat, but this has not been highlighted as an important method of transmission in outbreaks. Birds processed during the viraemic stage will contaminate other carcasses with blood or faecal material containing virus. Packaging and the drips that develop during storage are also important, as both can be contaminated with virus from infected carcasses. On the basis of the Australian experience, however, there is no evidence that carcasses and animal products have contributed to recycling virus back to poultry. All Australian outbreaks were controlled soon after infection became established in poultry, leaving little opportunity for spread to occur by this route.

AI viruses have been isolated from duck meat following export to other countries (Tumpey et al 2003). The isolated viruses were pathogenic for chickens but did not produce clinical disease in ducks, although the virus multiplied to high titres in many tissues and the oropharynx.

Meat products

Virus can persist in poultry meat products.

In setting minimum processing conditions for cooked chicken-meat imports from New Zealand, the Australian Quarantine and Inspection Service reviewed the published literature on thermal inactivation of AI viruses in 1991 (AQIS 1991). Although the inactivation times were found to vary between virus strains, the following agreed minimum core temperatures for imports of cooked poultry meat from New Zealand are considered sufficient to kill AI viruses:

- 70°C for a minimum of 30 minutes;
- 75°C for a minimum of 5 minutes; or
- 80°C for a minimum of 1 minute.

The actual cooking temperatures and times used for poultry products are shown in Table 1.3.

Table 1.3 Cooking temperatures and times for various poultry products

Product	Temperature (°C)	Time	Temperature inside product (°C)
Nuggets			
– fully cooked	210	1 minute (average)	75
– partially cooked ^a	196–207	27 seconds	(–1) ^b
– further cooking at fast-food outlets	182	10–15 minutes	85
Roast chicken			
– chicken loaf	215	60 minutes	85–90

a Flash fried

b Nuggets are held at –1°C before partial cooking and then subjected to a short period at a high temperature. They are further cooked at fast-food outlets.

Source: Arzey (1989)

Industry sources claim that precooked products for the retail market such as roasted and smoked poultry and poultry rolls, and secondary products such as poultry stock cubes, soup mixes, and canned and dried pet foods, all satisfy the minimum core temperature requirements. However, for flash-fried products, such as nuggets, the cooking time is so short that the internal temperature is unlikely to be raised sufficiently to kill the virus. Further cooking at fast-food outlets, however, should be sufficient to kill the virus. The virus may also survive in fully cooked nuggets, as they only reach a core temperature of 75°C for one minute. However, fully cooked nuggets are recooked by the consumer before serving.

Experimentally, heat inactivation of AI virus appears to be dependent on the strain of the virus and the medium in which it is suspended during testing. Infectivity of most strains was lost after heating to 60°C for five minutes, and 56°C for 15–30 minutes; however, some strains required up to six hours at 56°C for inactivation (Biosecurity Australia draft generic IRA report for chicken meat, DAFF 2006⁷).

The OIE Terrestrial Code's recommendation for the inactivation of AI virus in poultry meat is that the meat reaches a core temperature of 70°C for one second.

The World Health Organization (WHO) INFOSAN website states that 'the virus is inactivated at temperatures reached during conventional cooking (at least 70°C at the centre of the product ... or when the meat is not pink in any part)'.⁸

Table eggs and egg products

Although severely affected birds will stop laying, eggs laid in the early phase of the outbreak could contain AI virus in the albumen and yolk and/or on the shell. The virus can penetrate cracked or intact shells and, more significantly, contaminate the egg fillers. The survival time on the eggs and fillers is sufficient to allow wide dissemination. Eggs and fillers can be sanitised with a sanitiser containing 50–200 ppm of available chlorine, or other registered sanitiser. Eggs laid by birds with LPAI infections have significant external AI virus contamination, as the oviduct is a site of virus reproduction.

⁷ <http://www.daff.gov.au/ba/ira/current-animal/chicken-meat>

⁸ See <http://www.who.int/foodsafety/micro/avian/en/index1.html#section%201>

Egg pulp products could be another source of the virus. Current pasteurisation procedures and cooking procedures for egg products are shown in Table 1.4.

Table 1.4 Pasteurisation procedures for egg products

Product	Temperature (°C)	Time (minutes)	Temperature inside product (°C)
Liquid whole ^a	64	2.5	–
Liquid yolk ^a	60	3.5	–
Liquid white ^a	55	9.5	–
Pavlova line ^b	150	45–55	80
Dry whole/yolk ^b	187	–	71

a Minimum times and temperatures given in FSANZ (2011); after heating for the required time, products must be rapidly cooled to a temperature no greater than 7°C.

b Arzey (1989)

However, these conditions are not sufficient to inactivate AI virus, which requires at least 4.5 minutes at 64°C, 5 minutes at 60°C or over 15 minutes at 55°C (Moses et al 1948).

The OIE Terrestrial Code recommendations for the inactivation of AI virus in eggs and egg products are shown in Table 1.5.

Table 1.5 OIE Terrestrial Code recommendations for the inactivation of AI virus in eggs and egg products

Egg products	Temperature (°C)	Time
Whole egg	60	188 seconds
Whole egg blends	60	188 seconds
Whole egg blends	61.1	94 seconds
Liquid egg white	55.6	256 seconds
Liquid egg white	56.7	228 seconds
10% salted yolk	62.2	138 seconds
Dried egg white	67	0.83 days
Dried egg white	54.4	21.38 days

Fertile eggs

AI virus has been isolated from eggs laid by infected breeding hens.

Poultry byproducts

Rendered meals, produced from frames (boned-out skeletons), viscera, blood, feathers, feet, heads, necks, offcuts, birds dead in trucks and discarded live birds, are added to poultry feed as poultry offal meal and tallow. They may also be added to pet foods.

Poultry offal meal and pet foods are usually cooked at above 100°C for from several minutes to more than one hour, which is sufficient to kill AI virus. However, if the procedure is not carried out properly or cooked product is subsequently contaminated by unprocessed product, AI virus could persist in the byproduct for several weeks.

Waste products

Waste can be any of the unwanted byproducts of processing. All products that go into the production of rendered meals may also be discarded as waste. In addition, there will be wastes from hatcheries, laboratories (cultures and specimens, dead birds), farms and egg marketing establishments (unsaleable eggs, egg shells after pulping, solid egg fillers), as well as chicken manure and litter. AI virus has the potential to persist in these products and could be spread by vehicles that transport them unless the products are treated before movement. Composting infected carcasses and internal organs for 10 days has been reported to eliminate HPAI infection (Senne et al 1994).

Fomites

Persistence of the virus in faeces and respiratory secretions (see *Live poultry* above) is of major importance. Their stickiness facilitates spread over a wide geographical area on footwear, clothing, equipment and other fomites. This is the main way infection is transmitted between premises.

1.6.3 Modes of transmission

[In future, this section will also address cage and zoo birds.]

Not all strains of AI viruses are highly transmissible for poultry; highly and lesser pathogenic viruses can begin with low transmissibility but, following passage through flocks, transmissibility as well as virulence for the host can increase in the field.

In the early part of the twentieth century, live bird movements through markets and the shipping trade were the principal means of the epidemic spread of infection. The significance of live poultry markets in generating and spreading HPAI has been observed in Hong Kong in 1997, 2001 and 2002, in the northeastern United States from the 1990s to the present, and in Southeast Asia in 2004. Live market movements have also assisted the dissemination of LPAI viruses in the United States. Infection from contact with fresh poultry, meat or eggs has not been recorded in either the Netherlands (2003) or eastern Asia (1997–2004).

In recent times, dissemination of HPAI virus between flocks has been primarily attributed to:

- the movement of infected birds (including vaccinated birds); and
- the actions of humans in moving feedstuff, personnel, equipment and vehicles into and from premises that are contaminated with infected faeces or respiratory secretions.

Reductions in, and controls on, the movement of live commercial poultry and improved biosecurity have meant that spread by live birds is now less important. Contamination of personnel and fomites is now the principal way that infection spreads during outbreaks.

Epidemiological studies in the northeastern United States have shown that AI viruses detected in the live bird trade usually remain LPAI, but they have been a source of infection for commercial poultry in New York, Pennsylvania, Delaware and New Jersey from the 1990s to 2004 (Davison et al 2003, Henzler et al 2003, Panigrahy et al 2003, ProMED 2004d). Outbreaks in commercial poultry were dealt with by slaughtering birds on infected premises (IPs) and cleaning and disinfection, for fear that HPAI would develop through passage in domestic chickens. It was noted that depopulating IPs quickly led to infection on

nearby properties; this was reduced by orderly marketing of the birds through slaughter after infection had died down, rather than rapid slaughter (Henzler et al 2003).

Studies of the live bird markets of the northeastern United States showed that markets operating the most intensive schedules, and selling both birds and animals, had the highest risk of AI infection (Bulaga et al 2003).

Although aerosols may have caused some secondary spread during the New South Wales outbreak in 1997, aerosols and windborne contamination have not been regarded as important in the spread of infection (Swayne and Suarez 2000).

Wild birds

Direct or indirect contact with waterfowl is the most likely source of infection in poultry (see Sections 1.2, 1.6.2 and 1.7). Studies have been undertaken in Italy, the Netherlands and the United States on the isolation of AI viruses from wild waterfowl; over a period, nearly every H and N subtype virus can be isolated from waterfowl throughout the year, with AI viruses being isolated from 0.5% to 26% of samples (Alfonso et al 1995, De Marco et al 2003, Fouchier et al 2003, Hansen et al 2003). An Australian study in 2001–02, of samples from wild birds in Victoria, isolated H3N2 viruses from wild ducks (Peroulis and O'Reilly 2004).

During the 1985 AI outbreak in Victoria, a virus of the same serotype was isolated from a starling trapped on the infected farm (Morgan and Kelly 1990).

Monitoring for HPAI in wild birds was undertaken in Italy in 1999–2000, when there were outbreaks on 413 premises and 13 million poultry died. Some 103 dead wild birds were collected in the winter, and virulent virus was isolated from only two samples: one from sparrows that died in an infected poultry shed and one from a dove that died 1 kilometre from an IP. Therefore, in this widespread and virulent outbreak, wild birds did not appear to be an important means for disseminating virus (Capua et al 2000c). Monitoring wild birds during the Netherlands outbreak in 2003 enabled virus isolation from four ducks and three mute swans from 85 samples.

In the H5N1 epidemic in eastern Asia (1997–2004), deaths of waterbirds were reported in Hong Kong in 2002 and a dead falcon was reported infected in 2004. There were reports of deaths in overwintering birds in areas of Thailand near outbreaks among chickens, but no investigation appears to have been made into the cause of death.

Live poultry

Transmissibility in poultry varies enormously between AI virus strains. Contact with faeces or respiratory secretions is important, while airborne spread is not considered significant. Work in the United States has detected virus in air samples only, to 45 metres downwind of infected flocks, indicating limited spread through aerosols. However, Henzler et al (2003) believed that depopulating IPs early in the infection cycle led to spread of infection to nearby properties; this spread was reduced by orderly marketing of the birds in the normal production cycle after infection had died down.

Experimental work in turkeys showed that infection readily passed to susceptible birds on contact, but not to birds housed one metre off the floor. Westbury et al (1981) also showed that A/duck/Victoria/76 (H7N7) was able to spread quickly to contact chickens but A/chicken/Victoria/76 (H7N7) spread slowly. The methods of spread from bird to bird are therefore poorly understood. Field outbreaks are further complicated by having to distinguish between direct transmission and secondary spread by people and fomites.

Overall, access of naive birds to fomites contaminated with infected faecal material poses the greatest risk of spreading infection.

Eggs

Vertical transmission via infected eggs has never been proved, although AI virus has been detected on the shell surface and in the yolk and albumen of eggs, suggesting that the potential for spread exists. Normal incubation temperatures of 38.7°C in the early stages of embryo development may be lethal to AI virus, or infected embryos may be killed by the virus early during incubation. Persistence through the incubation process is most likely through shell contamination.

Fomites

Overseas experience has shown that AI can spread very rapidly and can be carried over long distances by transport of contaminated materials such as bird cages, pallets, egg filler flats, manure and feed, and on contaminated clothing, equipment and vehicles.

Other vectors

There is no evidence to suggest that invertebrates are involved in the interepidemic maintenance of transmission (Easterday and Beard 1984). However, there is a possibility of mechanical transmission by either invertebrate or vertebrate vectors through contact with infected faeces, although such transmission would be infrequent.

1.6.4 Factors influencing transmission

The principal means by which highly and lesser pathogenic AI viruses initiate outbreaks is through the contamination by wild birds of food or water supplies of poultry, and subsequent spread of infection through the movements of infected live birds or of faecally contaminated feed, equipment, materials and personnel. Infected backyard poultry and live bird markets can be a source of AI virus for commercial poultry, so it is important that the commercial poultry industry operates with strict biosecurity measures to prevent the inadvertent transfer of infection to commercial flocks.

Virus spreads more efficiently in winter than in summer because lower temperatures and higher relative humidity favour virus survival.

Improving biosecurity is the most important way that poultry producers, zoo personnel and the owners of cage birds can prevent the spread of virus. This includes:

- *biocontainment* – containment of the virus on IPs; and
- *bioexclusion* – prevention of introduction of the virus to naive premises (Swayne and Suarez 2000).

1.6.5 Human and animal influenza viruses

Influenza viruses are usually adapted to a particular host species. Transmission occurs between individuals of the host species and between closely related species (eg between chickens and turkeys or waterfowl and turkeys). Interspecies transmission between birds and mammals has only occurred rarely (Swayne and Suarez 2000).

The reservoir for all 16 haemagglutinins (H) and 9 neuraminidases (N) of influenza viruses is wild aquatic birds, particularly waterfowl, in which they multiply in the gastrointestinal tract to produce large amounts of virus, usually without clinical signs. Influenza viruses

with new combinations of H and N genes are generated by genetic re-assortment ('antigenic shift'), which occurs when cells of the host are co-infected with two genetically different viruses.

In wild waterbirds, the H and N subunits appear to be stable (Reid et al 2003) and the viruses do not cause disease. However, when viruses with new H and N combinations infect chickens and turkeys, a proportion tend to mutate and produce strains that cause severe disease in those species. Epidemics of AI have occurred when an HPAI virus with either an H5 or an H7 H is introduced to a naive poultry population. Similarly, influenza epidemics occur in humans when there is antigenic drift in the H gene of human influenza viruses; pandemics occur when there is a major antigenic shift, such as when the H is changed.

It is not clear why AI virus H5N1, which had been present in China since at least 1997, subsequently broke out across eastern Asia, but there were various gene assortments and mutations (Shortridge 2003).

In influenza terminology, it is thought that the antigenic shift in a human virus that occurred in 1918–19 was caused by the H of an avian virus entering the pig population through co-infection with pig and avian influenza viruses in the respiratory tract cells of a pig. The new pig virus then underwent a similar re-assortment in human respiratory tract cells, producing a virus with the pig (formerly avian) H that was capable of spreading in humans. However, some recent research has shown that the 1919 virus may have had an H of direct avian origin, rather than an avian-to-pig origin (Stevens et al 2004).

In 1997, H5N1 AI virus infection of 18 humans (mostly children) occurred in Hong Kong. All had had close contact with AI-infected chickens; six died. After the outbreak, 17% of poultry workers showed evidence of inapparent infection (OIE 2003). Further cases were recorded in Hong Kong in 1999 and 2003 (including one case of H9N2 strain). Also in 2003, 453 people reported health complaints associated with the management and depopulation of chicken flocks infected with the H7N7 virus in the Netherlands; 89 became mildly infected with the virus and one died (Koopmans et al 2004). In early 2004, human infections occurred in Vietnam and Thailand (H5N1) and in Canada (H7N7). Further human infections have occurred in Vietnam, Cambodia, China, Indonesia and Thailand since early 2005. Since 2006, cases have also been confirmed in Egypt, Turkey, Laos, Nigeria, Azerbaijan, Djibouti and Iraq.⁹

Infected people have high levels of chemokines in their blood, and it is thought that cytokine dysfunction contributes to the pathogenicity of the disease in humans, as opposed to the generalised infection that occurs in poultry (Peiris et al 2004). Many of those who have become ill and died with H5N1 infection have been children.

Antigenic characterisation of the viruses from people and birds in Hong Kong in 1997 and 2003, and Vietnam in 2004, indicates that the virus has mutated (WHO 2004bc); the Vietnam strains of H5N1 are resistant to the antiviral drugs amantadine and rimantadine (WHO 2004d).

Human infection with H5 and H7 AI viruses has caused the World Health Organization to consider whether a new pandemic human influenza virus could be derived directly from birds, rather than through the intermediary infection of pigs (WHO 2004b). Fortunately, in these outbreaks, there were no cases of sustained person-to-person transmission of AI

⁹ http://www.who.int/csr/disease/avian_influenza/en/

viruses: all the people hospitalised were exposed to live poultry in the week before becoming ill. There was also no association between infection and eating or preparing poultry products (WHO 2004e).

It was claimed that chicken depopulation in Hong Kong in 1997, 2001 and 2002 averted the re-assortment of avian and human influenza viruses and therefore prevented a pandemic of human influenza (Mounts et al 1999, WHO 2004bc).

1.7 Social and economic effects

The Australian Bureau of Agriculture and Resource Economics estimated the gross value of production of the Australian egg industry in 2005–06 at \$340 million; the value of the chicken meat industry in the same year was \$1416 million.

In an outbreak of AI involving the poultry industry, the main losses will be from mortalities, which can be high, and reduced productivity. The stamping-out policy will cause further loss of income for an extended period. Disruption to the flow of product and reduced consumption and production may cause job losses on farms and in service and associated industries, depending upon the time it takes to bring the outbreak under control. Even a small outbreak will result in dislocation of the industry and its normal marketing patterns. Infection in grandparent and foundation flocks would cause loss of some valuable genetic material.

Export markets for poultry products are likely to close if the outbreak becomes established, but the period of closure may be reduced by the adoption of a zoning strategy. If the disease is allowed to become widespread and national production is affected, it is possible that domestic supply will not meet demand; it is in preventing this situation that vaccination has a role.

The eradication strategy and the movement controls that will need to be imposed and rigorously enforced if a zoning or compartmentalisation policy is to be pursued will likely result in severe disruption to many industry practices, including breeding programs and sales of eggs, chicks, poults, pullets, turkeys and meat birds. Any delays beyond the marketing age of the various commodities can cause greatly increased production costs and losses over a short time, and affect producers not directly involved in the outbreak through loss or disruption of supply.

Zoos and premises holding cage birds, including pet shops and aviaries may be affected directly by the outbreak or indirectly through movement controls.

It is important that restrictions be eased as soon as the control strategy and circumstances permit, so viable commerce can be resumed as soon as possible by as many premises as possible.

If the CCEAD is satisfied that the actions taken are adequate to contain the disease within the declared areas, and zoning or compartmentalisation procedures are in place, then all birds and avian products from the free area should be allowed to move unimpeded (overseas or interstate). Birds and avian products from the declared areas may be moved by permit, subject to an assessment of the risks involved and to efficient implementation of an industry national management plan and agreed standard operating procedures.

1.8 Manner and risk of introduction to Australia

Evidence strongly suggests that waterfowl are the likely source in many AI outbreaks (Geering et al 1995). The virus usually transfers to the susceptible flock through close contact between live birds, but transfer could also occur through the use of untreated water from dams or creeks that have been contaminated with waterfowl faeces.

Poultry products are considered unlikely to transmit infection between countries and flocks (Swayne and Suarez 2000).

The likelihood of the poultry epidemic in eastern Asia spreading to Australia has been estimated to remain low because:

- migratory birds return to Australia from the northern hemisphere without incident; and
- the Australian poultry industry operates with good biosecurity compared with that in Asian countries, where a large part of the poultry industry is free range.

If an Asian poultry epidemic were to spread to Australia, the risk of the general public becoming infected as a result of contact with live infected poultry would be very low. Sales of live poultry in Australian markets are very small, and such sales would be prohibited in the event of an epidemic.

1.9 Criteria for proof of freedom

OIE zoning and surveillance requirements (Chapter 1.3.5 and Appendix 3.8.1 of the OIE Terrestrial Code) lay down general standards for surveillance for disease agents in the event that an application is made to a trading partner for recognition of freedom. The procedures to establish proof of freedom from infection with HPAI and LPAI (H5/H7) need to be consistent with the recommendations of Chapter 2.7.12 and Appendix 3.8.9 (*Guidelines for the Surveillance of Avian Influenza*) of the OIE Terrestrial Code which provides specific guidelines for surveillance of AI.

Surveillance in the areas outside the restricted area (RA) and control area (CA) needs to include testing of flocks that show any clinical signs suggesting infection with AI viruses. Surveillance needs to include virological and/or serological investigations.

Establishing proof of freedom from AI can best be achieved by clinical observations and dead-bird sampling of repopulated sheds and possible disease outbreaks, rather than by widespread biological testing. Further testing may be considered in the light of epidemiological information; such testing will become important if an AI outbreak becomes widespread and mild or low pathogenicity strains of the virus are detected during the outbreak. Failure to take decisive action could lead to such modified strains again becoming widespread, with possible later reversion to virulence and HPAI.

The OIE Terrestrial Code allows for the status of a country, zone or compartment to be determined on the basis of a risk assessment, provided that 'notifiable avian influenza' (NAI, which includes HPNAI and LPNAI) is notifiable in the country and appropriate surveillance is in place. Based on surveillance, a country, zone or compartment may be considered to be free from NAI when HPNAI and LPNAI have not been present for at least the previous 12 months, based on surveillance in accordance with OIE guidelines. The surveillance may need to be adapted to parts of the country or existing zones or

compartments depending on historical or geographical factors, industry structure, population data, or proximity to recent outbreaks.

If NAI infection occurs in a previously NAI-free country, zone or compartment, free status can be regained three months after a stamping-out policy (including disinfection of all affected establishments) is applied, provided that surveillance in accordance with OIE guidelines has been carried out during the three-month period.

These time periods apply irrespective of whether vaccination is carried out. If Australia were to move into a vaccination program as part of the eradication strategy, the earliest that freedom from disease could be declared would depend on whether or not stamping out is carried out on all IPs, as follows:

- vaccination *with* stamping out of IPs – three months; or
- vaccination *without* stamping out of IPs – 12 months.

Importing countries may be prepared to accept less than the OIE standard and allow imports of Australian live birds, hatching eggs and avian products as part of normal bilateral agreements if infected and free zones, or free compartments have been established.

2 Principles of control and eradication

2.1 Introduction

Infection of commercial poultry flocks with highly pathogenic avian influenza (HPAI) virus would be recognised quickly. However, infection of poultry with avian influenza (AI) strains that are of low pathogenicity (LPAI (H5/H7) or LPAI (not H5/H7); see Sections 1.1.3 and 1.1.4), infection of cage or zoo birds with any strain of AI virus or the presence of HPAI virus in wild birds may not be recognised easily without ongoing surveillance. Although it would be desirable to eradicate all HPAI and LPAI (H5/H7) viruses isolated from commercial poultry or cage or zoo birds, the virulence of any isolate needs to be determined so that an appropriate control strategy can be formulated. The detection in Australian poultry or cage or zoo birds of an AI virus classified as LPAI (H5/H7) is taken seriously because spread of the virus may lead to HPAI virus arising by mutation and causing a much larger outbreak, with high mortalities as occurred in Pennsylvania, Mexico and Italy.

As some strains of H5, H7, H9 and H10 subtypes of AI viruses have been shown to be capable of infecting humans, the public health implications of any outbreak of HPAI, LPAI (H5/H7) or LPAI (not H5/H7)) should be assessed.

2.2 Principles for control and eradication of HPAI

The occurrence of human cases of bird-derived HPAI infections since 1997 has concerned the World Health Organization (WHO) and health agencies generally.

2.2.1 Stamping out

WHO has recommended that all HPAI outbreaks in poultry should be promptly stamped out (WHO 2004b). The organisation has also recommended protection procedures for workers undertaking poultry depopulation, to prevent dual human and avian AI infections in people, which might lead to a human influenza pandemic (see Sections 1.6.5 and 2.2.15; WHO 2004f). However, recognising the difficulty of controlling AI infections in poultry in Asia compared to Western countries, joint meetings of WHO, the OIE (World Organisation for Animal Health) and the Food and Agriculture Organization (FAO) have agreed that alternative controls, such as vaccination, are required to ensure that eastern Asia can get its poultry industry back into production.

AI virus is stable under a range of environmental conditions, particularly cool and humid conditions, allowing it to be spread directly from flock to flock by live birds, fomites or drinking water contaminated with infected faeces (see Sections 1.6.3 and 1.6.4).

The basis for eradication of HPAI in poultry flocks by stamping out is, therefore:

- the rapid imposition of effective quarantine;
- stamping out by isolation of infected and potentially infected birds, followed as rapidly as possible by the killing of the birds and the sanitary disposal of carcasses;
- decontamination;

- prevention of movement of contaminated materials; and
- rapid surveillance to ensure that all sources and the extent of infection are detected.

These principles will need to be combined with the following other strategies:

- comprehensive, integrated national surveillance and diagnostic programs;
- enhanced biosecurity practised at all levels of production and processing by all employees of companies, diagnostic laboratories and government agencies that have contact with poultry or equipment from poultry operations; and
- education of poultry farmers and other workers about AI control, and sharing of information on surveillance and control strategies at all levels in the production process.

Rapid reporting and diagnosis of suspected cases together with swift imposition of effective eradication and movement controls will be the key to achieving these objectives. These procedures have been recognised as effective in previous outbreaks of HPAI in Australia and elsewhere (Swayne and Suarez 2000).

In some specific circumstances, where other control and eradication measures are not succeeding, vaccination, with government control, may be considered as one element of a comprehensive control program (Swayne and Suarez 2000).

Similar principles and procedures apply to the stamping out of HPAI following the detection of virus in cage or zoo birds.

2.2.2 Infected premises, suspect premises and dangerous contact premises

Quarantine of infected premises (IPs) prevents spread of the disease from the property by prohibiting movement in or out of birds, products and materials. It is important to apply quarantine measures as early as possible in order to slow the rate of spread in an area and to allow the epidemiological situation to be fully assessed.

For this reason, quarantine needs to be imposed on suspect premises (SPs) and dangerous contact premises (DCPs), at least until the extent of infection spread is determined. In the past, it may have taken several weeks of strategic surveillance before confidence was obtained that other properties in the area were not incubating the disease. Rapid diagnostic technology such as real-time PCR and direct antigen tests can now assist with rapid evaluation of the extent of infection.

Risk assessment of DCPs will identify premises that have received live birds or avian products from an IP and therefore have a higher risk of being infected than premises with indirect contact with an IP through personnel, equipment or vehicles. This difference in risk needs to be reflected in the management of the DCPs. Very high-risk DCPs should be slaughtered-out before the flocks excrete virulent virus. Lower risk poultry DCPs may be process slaughtered.

IPs, DCPs and SPs are defined in Section 4.

2.2.3 Quarantine and movement controls

As HPAI is readily transmitted via live birds and fomites, strict control of the movement of birds, as well as anything that may have become contaminated with virus, will be essential. This will be achieved by immediate imposition of tightly controlled quarantine on all places

suspected of being infected. Quarantine should be imposed on all premises, including farms and zoos, on which infection is either known or suspected and should be strictly policed to ensure that no-one, including the owners, staff and visitors, leaves without changing clothes and footwear. Particular attention needs to be paid to workers on poultry farms who keep backyard poultry or other birds at home.

Effective quarantine of an area requires around-the-clock security to ensure that only authorised personnel in protective clothing are allowed to enter. It will be necessary to supervise the movements of residents onto and off the property and to ensure that all pets are confined. It may also be necessary to ban pigeon racing, bird shows and other avian concentrations in the outbreak area.

The possible AI infection of workers who are in contact with live birds, faeces and contaminated materials means that such workers need protection in an outbreak; worker protection is discussed in Section 2.2.15 and Section 4.2.

Restricted areas and control areas

The declaration of a restricted area (RA), which should include the IPs, DCPs and, if possible, SPs, helps prevent spread by restricting movement into, within and out of the area of susceptible birds, products, litter, equipment, feed, pets and vehicles. In some circumstances, people will be required to undertake disinfection procedures. Movement controls should not hinder the movements of the general public unless human infection with the outbreak virus is occurring. People may be subject to quarantine on the direction of health authorities.

The declaration of a control area (CA) around the RA will help to control the spread of the outbreak from within the RA. The CA is a buffer zone between the RA and the rest of the domestic bird population where normal operations can continue. If the outbreak involves commercial poultry and if the CA contains an appropriate place for poultry slaughter, permission should be given to remove meat birds from DCPs and SPs, following inspection, within 24 hours for slaughter where no sign of infection has developed during the declared incubation period and surveillance has been in place.

The RA and CA are defined in Section 4.1. Recommended movement controls are given in Section 4.2.

If an outbreak of HPAI is spreading quickly, declaration of the RA and CA will allow the rapid investigation of the extent of infection and scaling up of the response. It is important that the extent of area declarations in Australia be limited to as small an area as necessary to cover the likely extent of infection. The size of the declared areas can be reduced after initial investigations have determined the likely extent of infection. If the outbreak involves commercial poultry, delaying the slaughter of meat birds inevitably places pressure on the routine of orderly processing. While restricting movement provides distinct advantages for disease control, it may be necessary to implement a 'welfare slaughter' if overcrowding becomes a problem.

Understandable pressure to impose interstate (and possibly even intrastate) movement controls on poultry products may be expected. It is desirable to minimise such controls because they cause a large part of the economic losses suffered by the uninfected parts of the industry during a disease outbreak. Interstate commerce involving poultry products from outside the RA poses a low likelihood of disease transmission.

Zoning/compartmentalisation

Zoning or compartmentalisation could be used by some jurisdictions outside the CA to establish a free area that, after the required serosurveillance to prove freedom from AI, could be accepted by other countries as separate from the other parts of Australia for trade purposes. Section 1.9 gives information on establishing proof of freedom.

2.2.4 Tracing

The information obtained from tracing will help to decide the extent of the RA and CA and identify any additional DCPs and SPs. Information should be requested on Animal Emergency Information System (ANEMIS) forms.

- The critical date is determined as the earliest time the virus could have entered the IP, and should be consistent with the maximum incubation period of 21 days for poultry, designated in the OIE Terrestrial Code.
- As a first priority, movements to and from IPs and, where possible, DCPs should be traced for at least 21 days before the first observation of unusual morbidity or mortality. High-risk movements that need to be traced are those of birds, eggs, poultry products, manure, litter and waste. Movements of feed, equipment (including egg fillers, cages, trolleys and pallets) and people also need to be traced and contact flocks assessed for infection for the 3 days before unusual morbidity or mortality was observed on the IP.
- People involved with feed delivery, vaccinating crews, bird handling crews, tradespeople, company service people and veterinarians should be interviewed, and lists should be compiled of all their possible contacts for the 3 days after they visited any SP or DCP.
- The original source of likely introduction of the virus to the birds should be traced, as it could remain a source of further virus dissemination.

2.2.5 Surveillance

Ongoing strategic surveillance will aid the early detection of AI. Active surveillance should be initiated as soon as HPAI is suspected. Initially, the location of all commercial and backyard poultry, zoo birds and significant holdings of cage birds in the RA should be identified and mapped. A sample of birds of any domestic species that die in the RA should be checked for AI lesions, and specimens submitted to approved laboratories for virus isolation. The use of real-time PCR and tests such as the Directigen™ test provides the opportunity to conduct rapid diagnostic surveillance.

Field surveillance examinations should seek to detect changes in flock health. To avoid spread of virus, visits by local disease control centre (LDCC) officers should be limited to the investigation of reports of increased mortality and/or morbidity.

Intensive surveillance aims to identify potential new cases of AI. Because of the risk of spread of virus by personnel, equipment and vehicles, the following procedures should be adopted to enable continuing surveillance while minimising multiple farm visits by inspectors and other authorised personnel to premises in the RA and CA:

- dead bird pick-up and transport to a laboratory, or sampling and sending of samples to a laboratory;
- reporting on flocks by telephone or fax;
- telephone survey; and

- serological/virological testing.

Visits can then be arranged to any potential new cases identified.

There are three phases for surveillance:

- early in an outbreak, to define the extent of infection by clinical signs and virus isolation;
- later in an outbreak, to give confidence that the true extent of infection has been determined after recovered flocks have seroconverted; and
- if the disease becomes established and minimal disease control procedures are applied, such as vaccination, to determine where infection has spread.

Training needs

Surveillance officers or other authorised officers must be:

- familiar with the poultry industry, zoo operations or the cage bird world; or
- able to pass information to appropriate experts for interpretation.

If the investigation of wild birds becomes necessary, surveillance officers would need to be aware of the natural movements and behaviour of wild birds, or be able to draw upon the expertise of ornithologists.

Surveillance officers must have access to:

- for domestic and zoo birds, flock health records expected for the class of stock under normal circumstances; and
- a summary of the disease — a list, pictures and video of clinical signs and an example of how health and production records would change in flocks infected with AI virus.

Information required

Information from records and from owners/personnel will be required for high-risk flocks in the RA and CA. These could be flocks of any of the following types:

<i>Commercial poultry:</i>	<i>Domestic noncommercial:</i>	<i>Other:</i>
breeders	pigeons	zoo birds
started pullets	aviaries	
layers	pet shops	
meat chickens	backyard flocks	
turkeys	fancy flocks	
game birds and ratites		

A reporting procedure that includes the following observations needs to be established:

Perusal of records and interviews of owners/personnel for the following:

- any decline in feed and/or water consumption;
- any decline in egg production from normal to cessation;
- any increase in mortality, depression or respiratory disease; and
- any appearance of birds with swollen heads, or cyanosis of combs or wattles.

Field autopsy findings, which include any of the following:

- severe swelling of combs and wattles;
- cyanosis of the comb;
- haemorrhage and necrosis of the comb;
- periorbital oedema;
- swelling of the shanks and feet;
- petechial haemorrhages on the viscera;
- catarrhal tracheitis;
- tracheal oedema;
- petechial tracheal haemorrhages; and
- caseous tracheal exudate.

Decisions should be made locally on which laboratory will be responsible for laboratory testing, managing the reporting system and evaluating the results for the situations described below.

Surveillance during an outbreak needs to include:

- surveillance of premises around the IP, DCP and SP flocks and other sites where tracing has determined that birds, products and contaminated materials might have been moved from the IP;
- poultry integrators in the RA carrying out their own surveillance, and reporting by telephone or fax;
- LDCC officers carrying out regular surveillance of independent premises in the RA;
- inspection of birds on premises in the RA and CA with unusual morbidity and/or mortality;
- mapping to identify all susceptible birds;
- serosurveillance of breeding flocks in the RA;
- surveillance of free-range poultry flocks of chickens, turkeys, ostriches and ducks in the CA, which will serve as effective sentinels for the passage of AI virus from waterfowl to poultry; and
- surveillance for virus in cage and zoo birds.

All reports of a decline in the health of birds (decline in feed or water consumption or egg production, increase in mortality, depression or respiratory disease) should be investigated. A standard reporting procedure is outlined in Section 1.9.

Surveillance of wild birds to determine their potential involvement in the dissemination of the disease may also be attempted, but such virus is likely to have limited impact on the spread of the disease if biosecurity mechanisms limiting access of wild birds to domestic and zoo birds, especially commercial poultry, are already effective.

2.2.6 Treatment of infected birds

The prognosis for birds affected with virulent disease is poor. Those that survive are usually in poor condition and poultry may resume laying only after a period of several weeks, if at all. Treatment is ineffective and inappropriate, and should not be attempted.

2.2.7 Destruction of birds

Efficient, humane procedures must be employed to kill birds, preferably without moving them from the site. Methods, including neck dislocation for individual birds and gassing of poultry flocks, are fully described in the **Destruction of Animals Manual**.

The most appropriate method of destruction will depend on such factors as the species of bird, the type of premises involved, the weather, the availability of expertise and skilled workers, and physical resources. Handling dead birds produces less airborne contamination than catching and handling live birds, reduces the exposure of workers to contamination, and makes working in the recommended protective equipment more bearable.

Airborne dispersal of virus should be prevented by closing up bird houses during depopulation. Disinfection of the litter surface and containment of feathers, dander, etc will reduce the load of virus that can potentially be spread. Access of wild birds to premises containing domestic or zoo birds, especially commercial poultry, should also be taken into account when deciding on the order in which to start depopulation operations.

Whether to gas birds in their cages depends on the nature of the buildings, the species and size of the birds, the number of birds per cage and the timespan before they are removed (as it can be extremely difficult to remove dead birds from cages once rigor mortis is established). It may be better to remove birds from their cages alive and gas them in an enclosed trailer or container (skip) before rendering, burial or incineration.

The authorities used whole-shed destruction methods to slaughter-out designated poultry premises within 24 hours during the 2003 outbreak in the Netherlands. Sheds were enclosed, and birds were gassed on litter with carbon dioxide or in cages above floor level with carbon monoxide. Gases were vented before personnel re-entered the sheds, and the Dutch fire services supervised occupational health and safety (OHS).

For OHS requirements for personnel involved in destruction of birds, see Appendix 3.

If the AI virus is infectious for humans, personnel engaged in eradication should be vaccinated with the currently available human vaccine and be treated with antivirals (where appropriate). Face masks or other equipment supplying air to workers and goggles should be worn at all times when near birds. Personnel may also be asked to take part in monitoring, including blood sampling by the state/territory department of health, to see if they have become infected (see Appendix 3).

Although these preventive and monitoring measures are voluntary, personnel who do not agree to them should not be engaged in activities in which they could come into contact with infected birds or premises.

2.2.8 Treatment of products and byproducts

All products from infected birds and other items that contained, transported or came into contact with them will be contaminated with AI virus. Similarly, people who come into contact with infected birds need to follow strict decontamination procedures if AI virus is to

be contained to IPs. In addition, attention needs to be paid to ensuring that products from other premises in the area of infection do not transfer AI virus before infection is diagnosed on those premises.

Section 1.6.2 provides information on cooked products.

2.2.9 Disposal

One of the major objectives of the eradication program is prompt and effective disposal of contaminated material that cannot be effectively treated (eg dead birds, eggs, litter, manure, fresh or frozen carcasses, plant and equipment, and building materials). Disposal requires consideration by an expert group using a decision-making framework to define and document the most appropriate option (see the **Disposal Manual**). Available methods include burial, incineration, burning, rendering and composting.

The removal of very large numbers of birds in a short time presents environmental and logistical problems. A poultry shed full of meat birds close to market weight contains about 75–90 tonnes of organic material, of which 75% is water. If infected material must be transported for disposal, particular attention should be paid to preventing the spread of the virus. For example, truck body trays must be waterproof and all loads carefully covered with tarpaulins to ensure that material cannot be blown out.

Disposal may be either on or off the IP. Burial in a common site would be considered if a number of IPs in a given area have to be depopulated and decontaminated.

Incineration is a good method of disposal, but incinerators are mostly too small to be useful for poultry flocks and may not be near IPs. Burning in pits or on pyres has been used where no burial site is available, but is expensive because of the high water content of carcasses and may also be environmentally unacceptable.

Rendering is a good method of disposal if the rendering plant has enough capacity and if it can be effectively decontaminated afterwards. However, private rendering plants may not be willing to handle infected birds and eggs. A disadvantage is that infectious material would need to be transported from IPs to the plant.

Composting is an effective way to deal with dead birds, manure and litter waste. Material can be composted inside sheds or otherwise on site, eliminating the risk of spreading the virus during transport.

If litter is to be removed, it will be necessary to moisten the surface with a disinfectant and possibly heap the litter in mounds under plastic before removal.

2.2.10 Decontamination

Decontamination entails cleaning and disinfection of the infected site to remove all infective material.

Acidification of potentially contaminated drinking water to pH 2.5, chlorination by hypochlorite or oxidation by chlorine dioxide should minimise the spread of virus from lakes and dams.

Particular attention should be paid to the decontamination of litter. As the AI virus can survive up to 35 days at 4°C in faecal material, it is necessary to quickly disinfect the surface

of the litter and to use measures such as composting to thermally inactivate the virus (composting inside sheds has some advantages).

Contaminated fomites, such as clothing, footwear, crates, feed sacks, egg fillers and other equipment should be decontaminated, if possible, or destroyed.

For further information on appropriate disinfectants and methods of decontamination, see the **Decontamination Manual**.

2.2.11 Vaccination

Vaccination is an option in the control of HPAI and LPAI (H5/H7), and has been used successfully in control of the disease in some countries (China, Canada, Vietnam and Italy). However, vaccination alone will not ensure AI eradication but it should only be used in addition to culling, the adoption of appropriate biosecurity procedures and monitoring. Although inactivated vaccines may protect against clinical disease and reduce mortality and environmental contamination, they do not prevent infection in vaccinated birds which may shed low levels of virus without showing clinical signs.

In addition, when vaccine is used during an outbreak, the masking of infection and the risk of vaccination crews spreading infection remain of concern. In all vaccinated flocks there is a need to perform virological and serological tests to monitor for virus circulation and to provide evidence of the effectiveness of the vaccination program.

Joint WHO/OIE/FAO meetings recommended vaccination of poultry flocks to help achieve eradication in eastern Asian countries (FAO 2004bc). Under the OIE Terrestrial Code, whether vaccination is carried out or not does not affect the AI status of a country, zone or compartment.

In Australia, vaccination could be part of a response where the disease is likely to spread and is unable to be rapidly controlled by stamping out and other measures. Any decision regarding possible vaccination needs to be made as early as possible in the course of the incident to allow for the time lag inherent in making arrangements for field use of the vaccine. The decision whether to vaccinate and the options chosen in Australia will be determined by factors such as the species and types of birds at risk, the density and characteristics of the surrounding avian population (wild and domesticated), geographic considerations, epidemiological factors, the virus subtypes involved, public health concerns, the resources available and the availability of appropriate vaccines.

There is a number of ways in which AI vaccination could be used in an emergency animal disease (EAD) response, including:

- **Suppressive vaccination** — to reduce the virus load through the vaccination of animals that are at high risk of exposure to infection, for example in an infected area. Vaccination can reduce morbidity and mortality, and while it may not prevent infection in vaccinated birds, it can reduce the volume of virus produced by infected flocks. This approach is more likely to be used in intensive farming situations, particularly where resource constraints have created rate-limiting situations for destruction and disposal, for example a delay in carcase disposal. Under this regime, vaccinated birds are likely to be destroyed. Vaccination can involve all at-risk birds or a selected subset based on area or production type.
- **Buffer vaccination** — to create a population of less susceptible birds around the infected region to slow virus transmission and minimise spread beyond a defined area. Clearly, movement control is essential to prevent infectious material passing beyond the buffer.

The location and shape of the vaccinated population may be influenced by geography and by the demographics of the animal population at risk. Buffer size is dependent on the epidemiology of the pathogen involved, the livestock density, the resources available and other factors.

- **Targeted vaccination** — to assist the management of specific compartments such as free-range birds, breeding stock of high genetic value, and rare birds.

In conjunction with the biosecurity requirements applying generally, specific requirements may need to be imposed on all vaccinated flocks and individual birds. These should remain in place until destruction or process slaughter, or until freedom from infection is confirmed, and should include:

- movement restrictions on live birds and other things from vaccinated flocks to manage any increased risk that might be a result of vaccination concealing the presence of virus;
- evaluation of vaccine effectiveness by monitoring post-vaccination titres, where appropriate;
- use of methods differentiating infected from vaccinated animals or other clinical and virological monitoring, including use of sentinel birds, to look for evidence of infection in vaccinated flocks;
- for commercial poultry, designated timeframes for process slaughter or destruction of vaccinates;
- identification of vaccinated birds/flocks to ensure all are accounted for; and
- any other measures as required by the chief veterinary officer to manage risks in the particular situation.

Suitable exit strategies would be required for vaccinated birds and the controls placed on vaccinated flocks must include a clear endpoint:

- No further vaccination should be permitted after a specified period following slaughter of the last known naturally infected bird.
- All vaccinates should be destroyed or process slaughtered within a specified period, or the flock demonstrated to be free from infection. For commercial poultry, timeframes can be specified to accommodate production cycles, where this is appropriate and does not compromise the eradication strategy.

The vaccination of birds that cannot be held and monitored until destruction or process slaughter, or until freedom from infection is demonstrated, should not be approved.

2.2.12 Wild animal control

Wild birds, particularly waterfowl, that visit premises holding birds, may harbour and shed AI virus. They may introduce AI to an area, and have been implicated as the initial cause of AI outbreaks (see Section 1.6.3).

To minimise the risk of infection from wild birds, it is essential to practise high-level biosecurity on such premises. During eradication procedures, bird-proofing of quarantined and other bird houses and protection of contaminated sites from wild birds are essential disease control strategies and need to be rigorously enforced.

The detection of HPAI virus in a wild bird or birds would lead to epidemiologically based investigations being commenced in the area in which the bird was found. Such investigations may include sampling of live or dead wild birds and ensuring that public/private enterprises in the area holding birds are aware of the need for enhanced biosecurity. If widespread HPAI infection is found in wild birds, it may be necessary to

proclaim restricted areas, to conduct broad surveillance and to consider the use of vaccination.

Joint FAO/OIE/WHO meetings have recommended that slaughter of wild birds, including waterfowl, should not be part of control/eradication activities in eastern Asia (FAO 2004bc). AI virus cannot feasibly be eradicated from these populations, and it is the responsibility of bird owners to protect their birds from infection by preventing contact between domestic birds and wild birds or their faeces.

For further information, see the **Wild Animal Response Strategy**.

2.2.13 Vector control

The control and destruction of rats and mice are important, as they can act as mechanical carriers. A special control program should form part of the eradication program to reduce the dispersal of rats and mice from the contaminated site.

Flying insects can spread the disease mechanically (see Section 1.6.3). If practical, steps should be taken to reduce flying insect numbers and minimise the chance of flies entering bird sheds.

2.2.14 Sentinel and restocking measures

No repopulation can take place until at least 21 days after satisfactory cleaning and disinfection has been completed and the outbreak has been brought under control in the area.

Experience in the United States and Australia has shown that dead-bird sampling of repopulated sheds is more efficient for monitoring than placing sentinel birds in the buildings from the time of depopulation to repopulation.

2.2.15 Occupational health and safety and public health implications

Workers need to be protected from infection with AI viruses wherever there is contact with infected poultry, products and premises (see Appendix 3 and the WHO website.¹⁰

WHO has recommended taking steps to halt the further spread of epidemics in poultry populations in eastern Asia and giving high priority to the rapid elimination of H5N1 virus in bird populations as a matter of international public health importance. To limit the possibility of starting a human influenza pandemic, it has also recommended prudent steps to protect workers involved in controlling outbreaks (WHO 2004bfg).

The OHS measures to be taken in Australia have been agreed nationally; human aspects will be coordinated by local public health authorities, who will be guided and coordinated by the National Pandemic Influenza Action Committee (see Appendix 3). Treatment of workers with antiviral drugs and/or collection of blood samples will require the consent of each person and the knowledge and agreement of local public health workers.

Care will need to be taken to provide adequate training to personnel recruited from the general public about the measures needed to ensure their safety in the workplace. Poultry

¹⁰ http://www.who.int/csr/disease/avian_influenza/guidelinetopics/en/index3.html

industry workers, zoo personnel and government officers recruited to depopulate infected premises will also need adequate training.

2.2.16 Public awareness

A media campaign must emphasise the importance of zoo personnel, bird owners and poultry producers inspecting susceptible animals regularly and of reporting suspicious clinical signs and unusual deaths promptly (see Section 1.9).

Details of any imposed movement controls need to be made available and clearly explained. Poultry industry workers, zoo personnel and cage bird owners need to be made aware that illness, such as symptoms of mild influenza or colds, may follow contact with infected birds, and that they should seek medical assistance should any symptoms of influenza follow such contact.

Further information must be provided to the public to address concerns about the safety of poultry products.

Further information on how to manage a public relations and media campaign in the event of an emergency animal disease outbreak is provided in the **Public Relations Manual**.

2.3 Principles for control and eradication of LPAI (H5/H7)

The occurrence in Australian poultry flocks, or in cage or zoo birds of viruses that are classified under the EAD Response Agreement as LPAI (H5/H7) will pose special challenges because the viruses produce no or mild clinical signs of infection affecting the respiratory tract or egg production. From experience overseas, failing to take action on an incursion of an H5 or H7 subtype virus in commercial poultry has the potential for the infection to become widely disseminated, particularly in the cool and humid winter months, with the real chance that HPAI will emerge and that highly pathogenic viruses will spread rapidly, as occurred in the United States in 1983–84, Mexico in 1995 and in Italy in 1999–2000.

The WHO recommendation for a stamping-out policy currently applies only to HPAI outbreaks in poultry and where there is a risk of human infections, which could arise from HPAI (WHO 2004b). The OIE has made both HPAI and LPAI (H5/H7) notifiable diseases (HPNAI and LPNAI) and subject to international trade rules (see Section 1.1.3). LPAI (H5/H7) has not been recorded as producing clinical or inapparent infections in humans.

If LPAI (H5/H7) is detected in Australian poultry flocks, or in cage or zoo birds, the following risk factors will need to be assessed in arriving at a control/eradication program which may include vaccination:

- the species involved;
- the nature and severity of the clinical disease;
- whether the virus produces clinical illness or infection in humans;
- the rapidity with which the virus is spreading within or between flocks;
- the proximity to commercial poultry or other significant avian establishments;
- the density of bird populations especially poultry in the area of the outbreak;
- the possibility of spread to other areas;

- the possibility of a mixed population of viruses being present, with apparent LPAI (H5/H7) viruses masking subpopulations of HPAI viruses;
- the impact that the disease will have on the marketing of poultry products;
- the possibility of creating a vaccination zone and process slaughtering infected poultry flocks when major disease control activities can be undertaken, such as in the favourable, low-spread, summer months; and
- the costs and impacts of alternative response options.

The methods for the control of LPAI (H5/H7) infections in poultry are essentially the same as those for HPAI (see Section 2.2). The preferred control and eradication option will be stamping out for IPs, if the infection is detected early and immediate surveillance in the area using rapid diagnostic technology indicates no significant spread. Ongoing surveillance for LPAI (H5/H7) infections in at-risk premises will give confidence that infection has been contained and is not establishing widely. These control measures will need to be supported by strict biosecurity by poultry farmers and industry actions to limit the spread of virus in the industry.

However, where immediate surveillance indicates there has been some spread from the index property, vaccination needs to be considered. The principles of vaccination for LPAI are the same as for HPAI (see 2.2.11).

Further surveillance may be required if LPAI (H5/H7) causes few or no clinical signs and vaccination is being used as an adjunct to eradication. For surveillance, rapid techniques can be used for virus detection, followed by confirmatory testing to identify field viruses.

2.4 Feasibility of control in Australia

Controlling isolated HPAI outbreaks in commercial poultry enterprises has been shown to be feasible, with all five outbreaks of HPAI in Australia to date having been quickly controlled and the disease eliminated from infected establishments.

In an outbreak in which the disease is widespread or spreading rapidly, eradication will still be technically feasible but might be more difficult to justify on economic grounds. While the availability of vaccines will make eradication achievable over a longer term, the occurrence of human infections due to the outbreak virus will make eradication by stamping out the highest priority.

3 Policy and rationale

3.1 Summary of policy

The finding of any strain of HPAI or LPAI virus is notifiable to the Chief Veterinary Officer (CVO) of the state or territory in which the finding is made.

3.1.1 Overall policy for avian influenza classified as HPAI (except in wild birds)

Highly pathogenic avian influenza (HPAI) is a OIE (World Organisation for Animal Health) notifiable disease (HPNAI) that is highly lethal to poultry and has the potential to infect humans. An uncontrolled outbreak of HPAI would cause severe production losses with consequent dislocation and financial losses in the poultry and associated service and sales industries. It may also lead to morbidity and mortality in large numbers of cage and zoo birds.

When the Consultative Committee on Emergency Animal Diseases (CCEAD) determines that an infection in poultry, cage or zoo birds, is caused by a virus that meets the definition of HPAI and in its view is eradicable, and this advice is endorsed by the National Management Group (NMG), the policy is to eradicate the disease in the shortest possible period, while limiting the risk of human infection and minimising economic impact, by implementing the following strategies:

- *stamping out* by destruction of all birds on infected premises (IPs) where there is clinical disease or evidence of active infection with HPAI virus, and the sanitary disposal of destroyed birds and contaminated avian products to remove the source of infection;
- possible *pre-emptive slaughter* of birds on other premises, depending on information derived from tracing, surveillance and study of the behaviour of the disease;
- *quarantine and movement controls* on birds, avian products and associated items in declared areas to prevent spread of infection (a national standstill is *not* necessary for containment of AI);
- *decontamination* of facilities, products and associated items to eliminate the virus on IPs and to prevent spread in declared areas;
- *tracing and surveillance* to determine the source and extent of infection, and to establish proof of freedom from the disease;
- *enhanced biosecurity* at poultry establishments, and premises holding cage or zoo birds;
- *zoning and compartmentalisation* to define infected and disease-free areas;
- *a public awareness campaign* to communicate risk and promote cooperation from industry, zoos, cage bird owners and the community; and
- *protection of public health*, by requiring that personnel engaged in eradication activities be vaccinated (with the currently available human vaccine), be treated with antivirals (if appropriate) and wear protective clothing.

Vaccination may be considered if an outbreak of HPAI is likely to spread or has spread out of control.

Under the *Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses* (EAD Response Agreement) for cost sharing, HPAI (H5/H7) is a

Category 2 emergency animal disease (EAD) and HPAI (not H5/H7) is a Category 3 EAD. Category 2 EADs are those for which costs will be shared 80% by government and 20% by industry; Category 3 EADs are those for which costs will be shared 50% by government and 50% by industry.

When HPAI is confirmed on or threatens to spread to premises on which rare poultry, cage or zoo birds are present, the prime objective is eradication of the virus. A modified approach, including consideration of vaccination, may be appropriate, however, taking into account factors such as biosecurity, movement controls, ongoing tracing and surveillance, and timeliness in achieving disease eradication.

3.1.2 Overall policy for avian influenza classified as LPAI (H5/H7) in poultry

Low pathogenicity avian influenza (LPAI (H5/H7)) is an infection caused by a strain of avian influenza virus that is of H5 or H7 subtype and produces mild or no clinical disease in poultry. LPAI could mutate to HPAI and cause significant disease problems in the poultry industry, and lead to morbidity and mortality in large numbers of cage and zoo birds.

Such virus strains in poultry are classified as notifiable (LPNAI) according to OIE criteria, and because of the potentially severe consequences of an uncontrolled outbreak of these strains of AI mutating to HPAI, they are categorised under the EAD Response Agreement. LPAI (H5/H7) of subtypes H5 or H7 is a Category 3 EAD under the EAD Response Agreement for cost sharing. Category 3 diseases are those for which costs will be shared 50% by government and 50% by industry.

When CCEAD determines that an infection is caused by an AI virus that meets the definition of LPAI (H5/H7), the policy is to control and eradicate the disease, while limiting spread and potential for mutation to HPAI, using a combination of strategies, including:

- *tracing and surveillance to determine the source and extent of infection and to establish proof of freedom from the disease; followed by*

either

- *stamping out either as for HPAI, if the infection is limited in distribution in the poultry industry and destruction of infected flocks is manageable or by modified stamping out using process slaughter if processing capacity is available;*

or

- *vaccination and a modified approach to eradication, if the infection is likely to spread or has spread out of control;*

and

- *quarantine and movement controls on poultry, poultry products and associated items in known IPs to prevent spread of infection;*
- *decontamination of facilities, products and associated items to eliminate the virus on IPs;*
- *enhanced biosecurity at poultry establishments and premises holding cage or zoo birds in the vicinity;*
- *zoning and compartmentalisation to define infected and disease-free areas; and*
- *a public awareness campaign to communicate risk and promote cooperation from industry and the community.*

When LPAI (H5/H7) is confirmed on or threatens to spread to a premises on which rare poultry are present, enhanced biosecurity, movement controls (such as lifetime quarantine) and ongoing tracing and surveillance will be implemented. Vaccination may be considered.

3.1.3 Overall policy for avian influenza classified as LPAI (H5/H7) in cage or zoo birds

LPAI (H5/H7) is an infection caused by a strain of avian influenza virus that is of H5 or H7 subtype and produces mild or no clinical disease. LPAI could mutate to HPAI and lead to morbidity and mortality in large numbers of cage and zoo birds.

Because of the potentially serious consequences of the spread of these strains of AI, LPAI (H5/H7) in cage or zoo birds is a Category 3 EAD.

When CCEAD determines that an infection in cage or zoo birds is caused by such a virus, an assessment of the risks to animal and public health will be carried out, taking into account the species of bird involved, the clinical status of the birds, and their proximity to commercial poultry and other significant bird establishments and populations, and to public amenity areas. The policy is to limit the spread of the infection and its potential for mutation to HPAI, and the response will depend upon the assessed risk. A combination of strategies may be employed, including:

- *tracing and surveillance to determine the source and extent of infection and to establish proof of freedom from the disease;*
- *quarantine and movement controls on birds and associated items in known IPs to prevent spread of infection;*
- *stamping out as for LPAI in poultry, or a modified approach to control in accordance with the risk assessment; this may include vaccination if the infection is likely to spread or has spread out of control;*
- *decontamination of facilities, products and associated items to eliminate the virus on IPs;*
- *enhanced biosecurity at avian establishments in the vicinity; and*
- *a public awareness campaign to communicate risk information and promote cooperation from industry, zoos, cage bird owners and the community.*

When LPAI (H5/H7) is confirmed on or threatens to spread to a premises on which rare cage or zoo birds are present, enhanced biosecurity, movement controls (including lifetime quarantine) and ongoing tracing and surveillance will be implemented. Vaccination may be considered.

3.1.4 Overall policy for avian influenza infections classified as LPAI (not H5/H7) in poultry, or in cage or zoo birds

Avian influenza caused by a strain of virus that is neither HPAI nor LPAI subtype H5 or H7, and which is producing no or mild clinical disease, is not considered an immediate threat to Australia's domestic or zoo birds or public health. Such AI virus strains are classified as LPAI (not H5/H7), and their detection in Australia would not be treated as an emergency disease outbreak.

When the CVO determines that an infection is caused by such a virus, an assessment of the risks to animal and public health will be carried out, taking into account the virus subtype, the species of bird involved, the clinical status of the birds, and their proximity to commercial or other significant bird establishments and populations, and to public amenity

areas. No action will be required unless the risk assessment indicates an unacceptable threat to animal or public health. When a response is necessary, it may include:

- *tracing and surveillance to determine the spread of infection;*
- *enhanced biosecurity; and*
- *an industry-arranged control program.*

These AI subtype viruses (LPAI (not H5/H7)) are not categorised under the EAD Response Agreement for cost-sharing arrangements.

3.1.5 Overall policy for avian influenza infections classified as HPAI or LPAI in wild birds

Avian influenza infections classified as HPAI or LPAI in wild birds are not considered to pose an immediate threat to Australia's domestic or zoo birds, or public health. Their detection would therefore not be treated as an emergency disease outbreak in Australia. However, HPAI infections in domestic or zoo birds could have serious consequences for avian and/or public health.

Therefore, if HPAI infection is detected in wild birds, the CCEAD will be convened and an assessment of the risks to animal and public health will be carried out, taking into account the circumstances under which sampling occurred, the possible source of the virus, the species of bird involved, the clinical status of the sampled birds/population, and their proximity to commercial and other significant bird establishments and populations, and to public amenity areas.

The response to a finding of HPAI infection in wild birds will be measured, commensurate with the level of assessed risk posed to domestic and wild bird populations, and to public health. No destruction of wild birds will occur, other than for reasons such as animal welfare. For further details, see Appendix 2.

If widespread HPAI infection is found in wild birds only (ie not in poultry, cage or zoo birds), it may be necessary to proclaim restricted areas, to conduct broader surveillance and to consider the use of vaccination in domestic and zoo birds in the immediate vicinity.

If LPAI infection is detected in wild birds, no further action is required, however consideration may be given to increasing surveillance in commercial poultry and zoo birds in the immediate vicinity of the wild bird LPAI detection.

The CVO in the state or territory in which the incident occurs is responsible for developing an EAD Response Plan for the particular incident.

The 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 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, see the **Summary Document**.

Ongoing changes to plans need to be approved in accordance with Primary Industries Ministerial Council policy.

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, based on epidemiological information about the outbreak(s).

For information on the responsibilities of the state or territory disease control headquarters and local disease control centres, see the **Control Centres Management Manual, Part 1**.

3.2 Strategy for eradication of outbreaks of HPAI

The objective is to implement disease control strategies that will eradicate the disease from domestic and zoo birds and re-establish Australia's HPAI-free status in the shortest possible time. Stamping out is the most effective control method for eradication, and needs to be accompanied by appropriate quarantine and control measures, decontamination of infectious material on IPs, targeted tracing and surveillance, and enhanced biosecurity by all levels of the poultry production and processing industries, and by zoos and cage bird owners. Because of concerns about human health, the World Health Organization (WHO) has recommended that all HPAI outbreaks in poultry be promptly stamped out (WHO 2004b; see Section 2.1).

While vaccination was not considered an option for control programs in the past, in some circumstances vaccines may now have a role in an eradication strategy (see Sections 1.5.3 and 2.2.11). If HPAI is not being controlled effectively, a vaccination strategy can be developed for Australian conditions to dampen virus spread and protect elite flocks and other rare birds if a suitable effective vaccine has been identified and is available in the required quantities and within the time required (see Section 3.2.5).

It will be necessary to ensure regular and ongoing liaison, through the industry liaison officer, with industry, poultry owners and farm managers, and with zoos and cage bird owners to seek their involvement, cooperation and support for eradication, particularly with regard to stamping out, disposal, decontamination and improved biosecurity. Effective involvement with the media will also be needed to ensure informed reporting, and with the public to provide information and clear explanations.

3.2.1 Stamping out and pre-emptive destruction of birds

All birds on IPs will be subject to stamping out if there is clinical disease or evidence of active HPAI virus infection. Decisions on the destruction of birds on premises at high risk (because of their location or management) and dangerous contact premises (DCPs) will be based on the information that becomes available from tracing and surveillance, and the pathotyping of viruses. Proposed response activities, such as stamping out on IPs and pre-emptive destruction of birds on high-risk DCPs and other high-risk premises (such as contiguous premises), must be included in an EAD Response Plan approved by the NMG (see the **Control Centres Management Manual, Part 1**).

When HPAI is confirmed on a premises on which rare poultry, cage or zoo birds are present, the primary objective is eradication of the virus. A modified approach may be appropriate, taking into account factors such as biosecurity, movement controls (such as lifetime quarantine), ongoing tracing and surveillance, and timeliness in achieving disease eradication.

The important first steps to control the spread of infection will be to define the bounds of infection and place restrictions in that area to slow the spread of infection and prevent it getting out of the defined infected area. Pre-emptive destruction of birds on close-contact premises, including DCPs and suspect premises (SPs), can be undertaken to control infection spread in the infected area if the infection is spreading rapidly, and there are resources available to destroy and safely dispose of the birds and carry out decontamination. Where premises design and other factors allow, birds may be destroyed by gassing in skips, modified truck trays or sheds (see Sections 2.2.7 and 2.2.9). The **Destruction of Animals Manual** and the **Disposal Manual** must be consulted when deciding on the most appropriate means of destruction and disposal.

People engaged in eradication activities should be protected from infection (see Appendix 3). Personnel who do not agree to voluntary preventive and monitoring measures should not be engaged in activities in which they could come into contact with infected birds.

3.2.2 Quarantine and movement controls

A national standstill is not necessary for containment of AI infections, and would have a severe negative effect on the operations of the Australian poultry industry and on the welfare of poultry.

IPs, DCPs and SPs will be declared (see Section 4.1), and will be subject to quarantine and movement controls on items as outlined in Section 4.2. Movements of manure and litter off these premises will be prohibited unless, in exceptional circumstances, a permit is issued. Equipment (egg fillers, trolleys, pallets, etc) and eggs (table and fertile) may need to be destroyed on site, or they may be moved under permit after decontamination or sanitisation (see Section 4.2). Movements of people and vehicles will be controlled, and personal and vehicle decontamination will be required before leaving the premises. The access of wild birds to premises and water supplies will be restricted. Bird-proofing will begin as soon as possible. Pets will be confined. Infected poultry will not be allowed to be moved for process slaughter, but process slaughter should be used for uninfected flocks where feasible. Movement controls need to be applied as specified in Section 4.2.

DCPs will be subject to movement controls during investigations into the status of the premises and during the OIE-prescribed incubation period of 21 days. These restrictions will ease as the situation is better defined. It is important that restrictions on declared premises be eased as soon as circumstances permit.

There will be a declaration of two major disease control areas:

- a **restricted area (RA)** with a radius of between 1 and 5 kilometres from all IPs and including as many DCPs and SPs as possible – wherever possible, the RA will exclude major markets, poultry processing plants and general service areas; more than one RA may be declared; and
- a **control area (CA)** encapsulating each RA, with a boundary no closer to the RA boundary than 2–10 kilometres, to form a buffer between the infected and free areas – this will help contain the disease within the RA, will have its own level of restrictions, and will enable a reasonable level of commercial and other activities associated with birds to continue.

The initial boundary of the CA may correspond with the state/territory or other geopolitical border, but the boundary will be amended on the basis of epidemiological

evidence obtained over time to allow as much commercial activity as possible, in line with accepted disease control measures.

Within the CA, movements of birds, avian products and other items will be allowed. Processing establishments and markets may be able to continue to operate under permit after inspection and upgrading of hygiene and management practices. Sales, zoos, shows, pet shops, aviaries and pigeon races may be able to continue to operate under exceptional circumstances permits.

Permits will be required for movements out of the RA and CA of birds, avian products and other items. Permitted movements must meet the specific conditions in Section 4.2. Birds and avian products from the free area may enter the CA under permit.

If the CA contains an appropriate place for poultry slaughter, permission should be given to remove meat chickens from DCPs and SPs for slaughter within 24 hours following inspection and/or testing if no sign of infection has developed during the declared incubation period and surveillance has been in place. Risk of spread of infection is further reduced by supervised heat processing (cooking) of meat and offal from these birds (see Table 1.3, Section 1.6.2 and Section 4.2) and strict supervision of quarantine and the hygiene of the vehicles and equipment used to move them.

Movement controls should not hinder the movements of the general public unless human infection with the outbreak virus is occurring. Quarantine arrangements for humans will need to be agreed with health authorities.

See Section 4 for further details of declared areas, quarantine and movement controls.

Industry support for the eradication program through enhanced biosecurity measures on poultry farms and assistance with eradication procedures will be vital.

Zoning/compartimentalisation

To regain the earliest access to international markets, zoning or compartmentalisation should be implemented as soon as possible after the epidemiological investigations have been completed and the extent and severity of the disease have been determined. Zoning and compartmentalisation should be implemented in accordance with OIE standards (Chapters 2.7.12 and 1.3.5 (Zoning and compartmentalisation) of the OIE Terrestrial Code). Zones or compartments may be established on the basis of geographical areas, management practices in enterprises, infection status and/or vaccination policies. Potential free zones will be those areas outside CAs while free compartments could lie within CAs. To achieve free zone or compartment status, surveillance to prove freedom from infection within the zone or compartment will be required (see Section 1.9).

If an outbreak of an HPAI virus is rapidly spreading, establishing RAs and CAs containing all IPs as soon as possible will allow rapid investigation of the extent of infection and the later application of zoning or compartmentalisation. It is important that the declared infected areas in a country the size of Australia be limited to as small an area as necessary to cover the likely extent of infection.

The OIE defines a compartment as: 'One or more establishments under a common biosecurity management system containing an animal subpopulation with a distinct health status with respect to a specific disease or diseases for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.'

The relevant factors for establishing zones or compartments are as follows:

- Limits should be set on the basis of natural, artificial or legal boundaries (for zones) or on the basis of management and husbandry practices relating to biosecurity (for compartments).
- Documentation should be prepared using the guidelines defined by the OIE.
- Information establishing the claimed status for the zone or compartment should be available for scrutiny.
- The country's capacity to maintain the status of free zones and compartments should be documented, and records of the surveillance that supports continuing freedom from infection should be maintained.
- A request should be made to the relevant trading partners for recognition of the free zone(s) or compartment(s).
- For industry's operational purposes, each zone or compartment should be self-sufficient in poultry operations, including slaughtering.

The notifiable avian influenza (NAI) status of a country, zone or compartment can be determined on the basis of the following criteria:

- A risk assessment has been undertaken to identify all potential factors for NAI occurrence and their historic perspective.
- NAI is notifiable in the whole country, an ongoing NAI awareness program is in place, and all notified suspect occurrences of NAI are subjected to field and, where applicable, laboratory investigations.
- Appropriate surveillance is in place to demonstrate the presence of infection in the absence of clinical signs in poultry, and the risk posed by birds other than poultry; this may be achieved through an NAI surveillance program in accordance with Appendix 3.8.9 of the OIE Terrestrial Code.

An application for zoning or compartmentalisation of the country will require appropriate surveillance for the disease agent and the imposition of controls on the movement of birds and avian products between the infected areas, and free zones or compartments.

3.2.3 Treatment of infected birds

The treatment of infected birds will not be permitted.

3.2.4 Treatment of avian products and byproducts

Manure and litter disposal may require individual approval and treatment, depending on the premises and circumstances (see Section 2.2.8).

Heat treatment of eggs, meat and offal is detailed in Section 1.6.2.

People engaged in product treatment should be protected from infection (see Section 3.2.8 and Appendix 3).

3.2.5 Vaccination

Stamping out is the preferred control measure for HPAI unless the spread or likely spread of infection indicates that stamping out alone is not going to achieve eradication. Vaccination has not been a necessary option in past Australian outbreaks, but its usefulness

has been demonstrated in overseas outbreaks (see Sections 1.5.3 and 2.2.11). If the disease is spreading at a significant rate (as determined by the CCEAD and agreed by the NMG), vaccination, enhanced biosecurity and the other infection control measures will be implemented to protect flocks from infection. Further details on how vaccination might be used are provided in the *National Operating Policy and Procedures for the Use of Avian Influenza (AI) Vaccine in the Event of an AI Outbreak in Australia* (National AI Vaccine Guidance; NAIVE Group 2010).¹¹

To assist interpretation of surveillance information and to facilitate differentiation of infected and vaccinated birds (DIVA principles), consideration will be given to a variety of approaches such as sentinel birds and heterologous neuraminidase antigen testing.

Vaccination will be in accordance with a decision of CCEAD. Vaccination will be under the control of the CVO of the affected jurisdiction. Depending on the circumstances, specific requirements will be imposed on vaccinated flocks and/or birds as outlined in the National AI Vaccine Guidance (NAIVE Group 2010). It will be essential to maintain all the other strategies of the control/eradication program simultaneously.

The matters which will need to be considered in developing a response plan using vaccination include:

- The aim of the vaccination program.
- How early and in what quantity vaccine is needed and can be obtained.
- Logistical issues relating to program administration and vaccine delivery.
- Whether additional regulatory controls such as specific biosecurity arrangements will be required.
- The occupational health and safety issues posed by unvaccinated versus vaccinated flocks.
- The practicability of using process slaughter of vaccinated poultry through commercial poultry plants.
- The post-vaccination surveillance, monitoring and management of flocks.
- The decontamination of facilities in which a vaccinated flock is being replaced by an unvaccinated flock.

3.2.6 Tracing and surveillance

Tracing and surveillance will be conducted to determine the source and extent of infection and to establish proof of freedom from the disease. The principles that will be applied for tracing from IPs, DCPs and SPs are described in Section 2.2.4.

Because of the large number of movements of birds, products and service providers in the poultry industry, the task of tracing poultry will be time consuming. Tracing of zoo birds and significant holdings of cage birds will also be required and, if HPAI virus has been detected in wild birds, epidemiologically based investigations in the area in which the infected birds were found may be necessary. Tracing must begin as soon as possible after HPAI is suspected. Movements of birds, products, people, vehicles and materials to and

¹¹www.animalhealthaustralia.com.au/aahc/index.cfm?BDA6CF7D-A00F-3670-2401-D1FA0F0C1421

from the IP will be traced from at least 21 days before the first signs of disease until the imposition of full quarantine on the IP. The original source of the virus should be traced, as it could remain a source for more outbreaks.

During the outbreak, surveillance will be undertaken on those premises considered at risk, and include the following arrangements:

In the RA

Arrangements should be made for local laboratories to autopsy samples from all species of bird that are found dead. Flock health can be monitored by:

- twice weekly (or more frequently if needed) reporting by telephone/fax by poultry handlers, cage bird owners and zoo personnel, and dead bird pick-up, with field visit if needed;
- twice weekly (or more frequently if needed) telephone surveillance of SPs and dead bird pick-up, and field visit if needed;
- immediate serological/virological testing of breeding flocks (paired samples¹² two weeks apart, then weekly);
- swabbing of dead birds weekly for virus isolation (trachea and cloaca) in at least 50% of the commercial flocks in the RA; and
- quarantine of suspicious flocks, virus isolation and resampling of flocks after seven days;
- investigation of unusual disease conditions in wild birds.

In the CA

Flock health should be monitored by:

- follow-up of any unusual disease conditions, including in wild birds;
- paired serological samples two weeks apart, then weekly serological/virological sampling of breeding flocks;
- serological sampling of meat chickens and commercial spent hens at abattoirs;
- weekly telephone surveillance of susceptible flocks, including cage and zoo birds;
- weekly reporting on flock health;
- swabbing of dead birds weekly (trachea and cloaca) for virus isolation in at least 10% of commercial flocks in the CA; and
- quarantine of suspicious flocks, virus isolation and resampling of flocks after seven days.

Backyard poultry, and cage and zoo birds will be included in the surveys, although the main means of controlling the disease and gaining knowledge of its spread will be by defining the extent of infection in the commercial poultry flock (see Section 2.2.5). The sampling of live or dead wild birds may be necessary. Proof of freedom from HPAI can best be achieved by clinical observations and sampling of dead birds in repopulated sheds and in possible disease outbreaks, rather than by widespread testing.

¹² Samples collected from the same bird two weeks apart.

An application for zoning or compartmentalisation of the country will require appropriate surveillance for the disease agent and the institution of controls on the movement of birds and avian products between infected areas, and free zones and/or compartments. The surveillance carried out after zoning or compartmentalisation has been proclaimed, including surveillance for detection of infection in an infected zone and for freedom from infection in a free zone or compartment, will be structured using the known epidemiology of AI infection in domestic and zoo birds and perhaps wild birds, taking into account the OIE recommendations (Appendix 3.8.9 of the OIE Terrestrial Code). Quail and free-range flocks of chickens, turkeys, ostriches and ducks, especially where they are farmed near chickens, might be used as indicators for the passage of AI virus from wild waterfowl to poultry.

Thorough monitoring will be needed to ensure the early detection of AI infection in mammalian species, especially pigs (see Section 1.6.2). Any pigs on IPs and in the RA need to be monitored for infection, including by collection of samples for virus isolation and serology.

See Section 1.9 for further information about the measures that need to be taken to support a declaration of freedom from disease.

3.2.7 Decontamination

The **Decontamination Manual** must be consulted when deciding on the most appropriate means of decontamination and disposal.

As AI virus is relatively stable in faeces and litter, buildings, equipment, vehicles, manure and litter on IPs must all be cleaned and disinfected, or destroyed. People should undergo personal decontamination procedures. Other premises will be decontaminated as considered necessary. All items to be disinfected must be thoroughly cleaned before disinfection (see Section 2.2.10).

Decontamination should include standard insect vector and rodent control measures to minimise mechanical spread of the agent to nearby premises.

3.2.8 Public health implications

Personnel engaged in eradication activities (such as tracing and surveillance, and decontamination) should be vaccinated (with the currently available human vaccine), treated with antivirals (if appropriate) and be protected from infection by wearing protective clothing in accordance with the national occupational health and safety guidelines for AI. Face masks or other equipment preventing eye splash and supplying air to workers should be worn at all times when near birds.

Personnel showing symptoms consistent with influenza must not come into contact with infected birds, in order to reduce the chance of combination of AI virus with a human strain.

Personnel may also be asked to take part in monitoring involving the collection of blood samples by the state/territory health department to see if they have become infected. Personnel who do not agree to preventive and monitoring measures should not be engaged in activities in which they could come into contact with infected birds.

See Appendix 3 for national guidelines for the protection of people exposed to infected birds.

More information about the possible infection of humans with AI viruses is given in Section 2.2.15.

3.2.9 Public awareness and media

The **Public Relations Manual** is to be used from the Alert Phase of an outbreak. Media releases should conform with the recommendations in that manual and have a fact sheet on HPAI attached. The initial media release confirming HPAI needs to be cleared by the CVO (with input from the state/territory chief medical officer) and the state/territory agriculture minister's office, and circulated to CCEAD members before the first CCEAD teleconference.

See Section 2.2.16 for further details of what to include in a public awareness campaign.

3.2.10 Strategy following a finding of HPAI in wild birds

AI infections classified as HPAI in wild birds are not considered to pose an immediate threat to Australia's domestic or zoo birds, or public health, and would therefore not be treated as an emergency disease outbreak in Australia. However, HPAI infections in domestic or zoo birds could have serious consequences for avian and public health.

Therefore, if HPAI infection is detected in wild birds, an assessment of the risks to animal and public health will be carried out taking into account the circumstances under which sampling occurred, the possible source of the virus, the species of bird involved, the clinical status of the sampled birds/population, and their proximity to commercial and other significant bird establishments and populations, and to public amenity areas. Appropriate testing and diagnosis are important components of the policy. Confirmation of HPAI infection is obtained from the isolation and typing of an HPAI virus or the detection of genetic material from an HPAI virus. Because serology is not evidence of current infection, response action will not be taken based solely on serological results.

The response to a finding of HPAI infection in wild birds will be measured, commensurate with the level of assessed risk posed to domestic and wild bird populations, and to public health. If HPAI infection is detected, the CCEAD will be convened to consider the outcomes of the risk assessment including the value in further sampling, management of domestic birds in the vicinity, a communications strategy and any other appropriate measures. The extent of these activities is dependent on the likely spread of the virus and the consequences. If the initial laboratory testing is negative, or subsequent preliminary surveillance is negative, no further action will be undertaken. For further details of the response, see Appendix 2.

If LPAI infection only is detected in wild birds, no further action is required, however consideration may be given to increasing surveillance in commercial poultry and zoo birds in the immediate vicinity of the wild bird LPAI detection.

3.3 Strategy for control and eradication of LPAI (H5/H7)

In an outbreak of LPAI (H5/H7) in poultry, a strategic plan for stamping out or a modified approach (which may include vaccination) will need to be developed with the CCEAD and the NMG. The plan will be essentially the same as for HPAI. Special measures and adaptations of the HPAI measures are outlined in the following sections. These control measures will need to be supported by enhanced biosecurity at poultry establishments, and premises in the immediate vicinity holding cage or zoo birds, and industry actions to limit the spread of virus in the industry.

The detection of LPAI infection in cage or zoo birds will lead to an assessment of the risks to animal and public health, taking into account the species of bird involved, the clinical status of the birds, and their proximity to commercial and other significant bird establishments and populations, and to public amenity areas. The policy is to limit the spread of the infection and its potential for mutation to HPAI and the response will be dependent upon the assessed risk.

When LPAI (H5/H7) is confirmed on a premises on which rare poultry, cage or zoo birds are present, enhanced biosecurity, movement controls (such as lifetime quarantine), and ongoing tracing and surveillance will be implemented.

3.3.1 Stamping out

If rapid control and eradication of the outbreak in poultry are achievable, stamping out will be used. If the infection is found to have become widespread before detection, orderly destruction of infected flocks can reduce the level of infection. A program using stamping out will require consideration of the following matters:

- The action will need to be as rigorous as for HPAI, if eradication of the infection is to be achieved in a reasonable timeframe.
- Resources will need to be sufficient to sustain rapid slaughter and disposal of infected, dangerous contact and suspect flocks.
- As an initial step, the extent of infection should be determined using rapid diagnostic technology, such as real-time PCR. This has the potential to limit the size of the RA and CA while helping to restrict infection to the area in which control and eradication measures will continue.
- If infection in poultry is widespread and a longer timeframe for eradication is acceptable, process slaughtering of poultry in the RA or CA will enable depopulation through the marketing process and limit the economic impact of the outbreak.
- As for HPAI, all the ancillary regulatory controls for an EAD will need to be used to prevent further spread of the virus into the poultry industry.
- Tracing and surveillance will need to be thorough to ensure that infection is being kept under control.
- Thorough clean-up and disinfection will be required between production batches on all farms.
- Swift action will be taken to meet WHO and Australian health authority requirements for the protection of workers if the virus mutates into HPAI.
- People engaged in activities associated with the eradication of LPAI (H5/H7) do not need to be protected against infection as for HPAI (see Appendix 3).

3.3.2 Quarantine and movement controls

Quarantine and controls on the movement of infected birds, contaminated avian products and equipment such as transports and crates are core requirements for achieving disease control. Zoning or compartmentalisation may also allow time for the outbreak to be brought under control, and for the orderly destruction of infected poultry flocks by process slaughter in commercial poultry plants. See Section 2.2.3 for details of quarantine, movement controls and zoning.

An application for recognition of free zones or compartments in the country will require appropriate surveillance for the disease agent and the institution of controls on the movement of birds and avian products between infected areas and free zones/compartments. The surveillance carried out after zoning or compartmentalisation has been proclaimed, including surveillance for the detection of infection in an infected zone and for freedom from infection in a free zone or compartment, will be structured using the known epidemiology of AI infection in domestic and zoo birds. Quail and free-range flocks of chickens, turkeys, ostriches and ducks, especially where they are farmed near chickens, might be used as indicators for the passage of AI virus from waterfowl to poultry.

Further information is provided in Section 3.5 about the measures that will be taken to support a declaration of freedom from disease.

3.3.3 Treatment of infected birds

The treatment of birds infected with LPAI (H5/H7) would be ineffectual, and will therefore not be permitted.

3.3.4 Treatment of avian products and byproducts

The safe disposal of manure, litter and other wastes from IPs and SPs is critical for disease control purposes (see Sections 2.2.8 and 3.2.4).

Section 4.2 lists movement controls for products and byproducts. For LPAI (H5/H7), some of the restrictions on the movement of birds and products might be less stringent than for HPAI.

3.3.5 Vaccination

The points to be considered in developing a vaccination strategy for LPAI (H5/H7) are as for those discussed in Section 3.2.5.

3.3.6 Tracing and surveillance

The principles of tracing and surveillance in an LPAI (H5/H7) outbreak are essentially the same as for HPAI (see Section 3.2.6). Section 1.9 provides further information about the use of surveillance procedures. In an outbreak caused by LPAI (H5/H7) virus in which birds are not showing clinical signs, tracing and surveillance by virus isolation, virus detection and/or serology would be very important for the containment and eradication of infection. Surveillance should be undertaken using rapid diagnostic technology, such as real-time PCR, to speed the clarification of infection on the status of premises. The use of vaccination in the control program will require the use of DIVA principles and sentinel unvaccinated birds to ensure that vaccinated birds can be distinguished from birds infected with the outbreak virus.

Thorough monitoring will be needed to ensure the early detection of AI infection in mammalian species, especially pigs (see Section 1.6.2). Any pigs on IPs and in the RA need to be monitored for infection, including by collection of samples for virus isolation and/or serology.

Proof of freedom from LPAI (H5/H7) on IPs can best be achieved by clinical observations and sampling of dead birds in repopulated sheds and in possible disease outbreaks, rather than by widespread testing.

3.3.7 Decontamination

The **Decontamination Manual** must be consulted when deciding on the most appropriate means of decontamination and disposal.

3.3.8 Public health implications

Information about the possible infection of humans with AI viruses is given in Sections 1.2 and 2.2.15. Although LPAI (H5/H7) does not require specific protection of workers beyond that required for normal workplace hazards, the emergence of HPAI would require the protection of workers as described in Appendix 3.

3.3.9 Public awareness and media

The **Public Relations Manual** is to be followed from the Alert Phase of an outbreak. Media releases should conform with the recommendations in that manual and have a fact sheet on LPAI (H5/H7) attached. The initial media release confirming LPAI will need to be cleared by the CVO (with input from the state/territory chief medical officer) and the state/territory agriculture minister's office, and circulated to CCEAD members before the first CCEAD teleconference.

If it is proposed to process slaughter infected and vaccinated flocks, a clear public communications program needs to be developed to avoid public misunderstandings about what is being undertaken.

3.4 Funding and compensation

HPAI caused by virus of subtypes H5 or H7 is classified as a Category 2 EAD in the EAD Response Agreement.¹³ Category 2 diseases are EADs that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the livestock industries that are involved. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).

HPAI caused by virus of subtypes not H5 and H7 is classified as a Category 3 disease. LPAI caused by virus of subtypes H5 or H7 is also classified as a Category 3 disease, and control and eradication arrangements are required. Category 3 diseases are EADs that have the potential to cause significant (but generally moderate) national socioeconomic consequences through international trade losses, market disruptions involving two or more states and severe production losses to affected industries, but have minimal or no effect on human health or the environment. For this category, the costs will be shared 50% by governments and 50% by the relevant industries (refer to the EAD Response Agreement for details).

The detection of HPAI or LPAI in cage or zoo birds has not been categorised under the EAD Response Agreement.

AI infections classified as LPAI (not H5/H7) are not subject to the EAD Response Agreement; nor are they designated diseases in the disease control legislation of all states

¹³ <http://www.animalhealthaustralia.com.au/programs/eadp/eadra.cfm>

and territories. This means that the costs of the control of such infections, including compensation to owners for the destruction of birds, will not be shared by governments and industry.

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

3.5 Strategy if the disease becomes established

If HPAI were to become established, properly applied hygiene measures and widespread vaccination could effectively limit transmission of AI infection. Coupled with a policy to stamp out infected flocks, government, the poultry industry, zoos and cage bird owners would have to collaborate in a preventive program incorporating:

- consultation;
- public education about the disease, the control program and the need to maintain good records;
- prevention of infection through programs to encourage isolation, bird-proofing of premises, exclusion of wildlife and rodents, and treatment of drinking water to kill viruses using chlorine, chlorine dioxide or ultraviolet light;
- monitoring for exposure to the disease agent by serological sampling of meat chicken flocks at processing plants and laying flocks on an annual basis;
- monitoring of cage bird premises and zoos for the presence of infection;
- rapid reporting of suspect flocks and their isolation until they can be confirmed negative or be destroyed;
- upgrading of hygiene and other biosecurity management procedures;
- effective high vaccination rates of all breeder and layer poultry flocks in the infected area, and of other birds considered to be at significant risk including rare/valuable birds; and
- public-private sector cooperation to trace the source of the outbreak and to improve future control strategies.

While a vaccination policy would assist the poultry industry economically, it may have implications for Australia's trading status, and the CCEAD would need to develop strategies to re-establish Australia's status of freedom from HPAI infection.

The movement of HPAI or LPAI (H5/H7) viruses into Australia's native bird populations may have unfortunate consequences if the viruses prove to be virulent or later acquire virulence.

4 Recommended quarantine and movement controls

4.1 Guidelines for classifying declared areas

When restricted areas (RAs) and control areas (CAs) are declared, they must not be larger than necessary. This will reduce the number of properties to be quarantined to only those deemed prudent. If poultry flocks in a quarantine area are not depopulated, the cost of keeping the birds beyond their normal market age could be substantial.

4.1.1 Declared premises

Infected premises

Premises classified as IPs will be defined areas (which may be all or part of a property) in which highly pathogenic avian influenza (HPAI) or low pathogenicity avian influenza (LPAI (H5/H7)) infection exists, or is believed to exist. An IP is subject to quarantine served by notice and to eradication and control procedures.

Dangerous contact premises

Premises classified as dangerous contact premises (DCPs) will be those that contain birds, avian products, waste or things that have recently been introduced from an IP (usually up to 21 days before the premises were declared infected) and are likely to be infected or contaminated. A DCP may also contain any of these items that may have been in substantial contact with people, vehicles and equipment that have been associated with an IP within three days before visiting the DCP. A DCP is subject to disease control procedures, which might include stamping out.

Suspect premises

Premises classified as suspect premises (SPs) will be those that contain birds that have possibly been exposed to an HPAI or LPAI (H5/H7) virus, such that quarantine and surveillance, but not pre-emptive destruction, are warranted; *or* birds not known to have been exposed to an HPAI or LPAI(H5/H7) virus but showing clinical signs requiring differential diagnosis.

The classification 'suspect premises' is a temporary classification because the premises contain birds that are suspected of having the disease. High priority should be given to clarifying the status of the suspect birds so that the SP can be reclassified as either an IP and appropriate quarantine and movement controls implemented, or as free from disease, in which case no further disease control measures are required.

4.1.2 Declared areas

Restricted area

An RA will be a relatively small declared area (compared to a CA) around IPs that are subject to intense surveillance and movement controls. Multiple RAs may exist within one CA.

The RA does not need to be circular but can have an irregular perimeter provided the boundary is initially an appropriate distance from the nearest IP, DCP or SP. This distance will vary with the size and nature of the potential source of virus, but will be between one and five kilometres from the IP, depending on the density of bird, especially poultry, premises. 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 birds, traffic patterns to markets, service areas and abattoirs, and natural barriers to movement. If possible, hatcheries should be kept out of the RA.

Control area

The CA will be a larger declared area around one or more RAs and, initially, possibly as large as a state or territory, where restrictions will reduce the risk of disease spreading from the RA. In general, surveillance and movement controls will be less intense (see Section 4.2), allowing reasonable commercial activities to continue.

The declaration of a CA helps control the spread of the outbreak from within the RA. The CA is a buffer zone between the RA and the rest of the bird population. The CA boundary does not have to be circular or parallel to that of the RA but should be 2–10 kilometres from the boundary of the RA.

4.2 Recommended quarantine and movement controls

4.2.1 Declared premises

Table 4.1 shows the movement controls that will apply to IPs, DCPs and SPs in the event of an AI incident. Unless otherwise specified, these controls apply both to HPAI and to LPAI (H5/H7).

Table 4.1 Movement controls for declared premises

Quarantine/movement control	Infected premises and dangerous contact premises	Suspect premises
<i>Movement out of poultry</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹ LPAI (H5/H7) – allowed by permit for immediate slaughter at approved abattoirs. Vehicles and equipment to be disinfected.	Allowed by permit, ² from inspected flocks with negative surveillance results; birds subject to immediate slaughter under supervision at approved abattoir. Waste to approved disposal. ⁷ Product subject to heat treatment ⁸ at approved premises. Vehicles and equipment to be disinfected. LPAI (H5/H7) – allowed by permit for immediate slaughter at approved abattoirs. Vehicles and equipment to be disinfected.
<i>Movement out of cage or zoo birds</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit, ² from inspected flocks with negative surveillance results. Vehicles and equipment to be disinfected.
<i>Movement in of susceptible birds</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit, subject to negative surveillance results. ³
<i>Movement out of nonsusceptible species</i>	Allowed by permit, subject to disinfection. Vehicles and equipment to be disinfected.	Allowed by permit, subject to disinfection. Vehicles and equipment to be disinfected.
<i>Movement out of litter and manure</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹
<i>Movement out of equipment and feed</i>	Allowed by permit, unless has been in contact with birds. Vehicles and equipment to be disinfected.	Allowed by permit, subject to disinfection. Vehicles and equipment to be disinfected.
<i>Movement in and out of people</i>	Allowed by permit, subject to appropriate washing.	Allowed, subject to appropriate washing.
<i>Movement in and out of vehicles</i>	Allowed by permit, subject to disinfection.	Allowed by permit, subject to disinfection.

Quarantine/movement control	Infected premises and dangerous contact premises	Suspect premises
<i>Movement out of fertile eggs</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO ¹ (eg for salvage of genetic stock, subject to sanitisation of eggs, disinfection of equipment and vehicles, and quarantine and surveillance of destination flocks).	Allowed by permit, subject to sanitisation of eggs, disinfection of equipment and vehicles, and quarantine and surveillance of destination flocks).
<i>Movement out of table eggs</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit, subject to sanitisation. Vehicles and equipment to be disinfected.
<i>Movement out of fresh/frozen meat and offal from susceptible birds</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹ LPAI (H5/H7) – allowed by permit. Equipment and vehicles to be disinfected. ⁵	Allowed by permit from flocks with negative surveillance; subject to heat treatment ⁸ at approved premises. ⁵ Vehicles and equipment to be disinfected. LPAI (H5/H7) – allowed by permit. ⁵ Equipment and vehicles to be disinfected.
<i>Movement in of feed</i>	Allowed by permit. Vehicles to be disinfected. ⁶	Allowed by permit. Vehicles to be disinfected. ⁶
<i>Movement out of abattoir waste</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO ¹ (eg for disposal ⁷).	Allowed by permit for approved disposal. ⁷ Vehicles and equipment to be disinfected.
<i>Movement out of dead birds</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO ¹ (eg for disposal).	Prohibited unless exceptional circumstances exist and permit is approved by CVO ¹ (eg for disposal).
<i>Movement out of horticultural and agricultural crops</i>	Allowed.	Allowed.

CVO = chief veterinary officer; LPAI (H5/H7) = low pathogenicity avian influenza caused by virus subtypes H5 and H7

NOTES:

- (1) This type of movement is approved, under permit, provided that the chief veterinary officer has cleared this type of movement (ie generally not each individual movement) with the Consultative Committee on Emergency Animal Diseases. Risk materials, vehicles and equipment would need to be disinfected.

- (2) If the CA contains an appropriate abattoir, permits can be issued to move meat chickens from SPs and from the RA following inspection (no birds showing clinical signs) and negative serosurveillance, for immediate slaughter (within 24 hours). The movement of the live birds requires careful selection of transport routes and disinfection of vehicles and equipment. The product from poultry will be permitted to move to approved premises outside the CA where it is subject to heat treatment sufficient to kill virus before being sold to consumers. Waste is to be subject to approved disposal.
- (3) Permits for movement of susceptible birds onto an SP or into an RA or CA should be issued with caution. Although such movements pose no risk of spreading infection, compensation would be payable if these animals were to become infected. Birds must remain on the property for at least 21 days and be inspected before any further movement, or be immediately processed.
- (5) If a processing plant has received birds from an IP or DCP since the date when they were infected or exposed to infection, the plant must be cleaned and decontaminated, under supervision, before operating again. Staff must undergo disinfection procedures before leaving the premises. Advice must be given to staff about poultry, cage and aviary birds or pigeons kept at their homes.
- (6) The vehicle must be disinfected on site, at a central point or back at the mill.
- (7) The refuse must be buried at an approved site and the vehicle cleaned and disinfected. The refuse must not be fed to or brought into contact with other birds.
- (8) Heat treatment must attain product core temperatures sufficient to kill virus before the product leaves the approved premises (see Section 1.6.2).
- (9) For the purposes of quarantine and movement controls, vaccinated birds will be treated the same as unvaccinated birds.

4.2.1 Declared areas

Table 4.2 shows the movement controls that will apply to RAs and CAs, including any vaccination zones. Unless otherwise specified, these controls apply both to HPAI and to LPAI (H5/H7).

Table 4.2 Movement controls for declared areas

Quarantine/movement control	Restricted area/ vaccination zone⁹	Control area/ vaccination zone⁹
<i>General</i>	Premises to operate at a very high level of biosecurity.	Premises to operate at a high level of biosecurity.
<i>Movement out of poultry</i>	Allowed by permit, ² from inspected flocks with negative surveillance; birds subject to immediate slaughter in CA under supervision at approved abattoirs. Product subject to heat treatment ⁸ at approved premises. Waste to approved disposal. ⁷ Vehicles and equipment to be disinfected.	Allowed by permit, ² from flocks with negative surveillance; birds subject to immediate slaughter under supervision at approved abattoirs. Product subject to heat treatment at approved premises. ⁸ Waste to approved disposal. ⁷ Vehicles and equipment to be disinfected.
<i>Movement out of cage or zoo birds</i>	Allowed by permit, ² from flocks with negative surveillance results. Vehicles and equipment to be disinfected.	Allowed by permit, ² from flocks with negative surveillance results. Vehicles and equipment to be disinfected.
<i>Movement in of susceptible adult birds</i>	Allowed by permit to an abattoir for immediate slaughter. Allowed by permit for restocking. Vehicles and equipment to be disinfected.	Allowed by permit. Vehicles and equipment to be disinfected.
<i>Movement within of susceptible birds</i>	Allowed by permit. ²	Allowed by permit. ²
<i>Movement through of susceptible birds of all types</i>	Allowed by permit. Birds not to be unloaded within RA.	Allowed by permit. Birds not to be unloaded within CA.

Quarantine/movement control	Restricted area/ vaccination zone⁹	Control area/ vaccination zone⁹
<i>Movement out of day-old chicks</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO ¹ (eg if eggs had been sourced from outside CA; destination flock subject to quarantine and surveillance). Vehicles and equipment to be disinfected.	Allowed by permit (eg if eggs had been sourced from outside CA). Vehicles and equipment to be disinfected.
<i>Movement out of replacement birds (pullets, breeders)</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit; subject to disinfection of equipment and vehicles; surveillance of source grower flock
<i>Movement out of litter and manure</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit. Vehicles and equipment to be disinfected.
<i>Movement out of feed and equipment</i>	Allowed by permit, unless has been in contact with infected birds. Vehicles and equipment to be disinfected.	Allowed. Vehicles and equipment to be disinfected.
<i>Risk enterprises, eg private avian laboratories, cull hen collectors, dead bird pick-ups etc (not processing establishments)</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Allowed by permit. Risk materials, vehicles and equipment to be disinfected.
<i>Sales, shows, zoos, pet shops, aviaries, pigeon races, etc</i>	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹	Prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹ Allowed by permit for nonsusceptible species.
<i>To and from processing plants</i>	HPAI – prohibited unless exceptional circumstances exist and permit is approved by CVO. ¹ If possible, processing plants should be kept out of declared RAs. LPAI (H5/H7) – allowed by permit. Vehicles and equipment to be disinfected. ⁵	HPAI – allowed by permit. Poultry from the CA can be processed following on-farm inspection within the previous 24 hours. Vehicles and equipment to be disinfected. Poultry from outside the CA can be slaughtered subject to vehicle disinfection before leaving the CA. LPAI (H5/H7) – allowed by permit. Vehicles and equipment to be disinfected. ⁵

Quarantine/movement control	Restricted area/ vaccination zone⁹	Control area/ vaccination zone⁹
<i>Movement of fresh/frozen meat, offal and waste from susceptible birds</i>	Allowed into or within RA. Allowed out of RA subject to heat treatment ⁸ at approved premises. Waste to approved disposal. ⁷ Vehicles and equipment to be disinfected. ⁵	Allowed into or within CA. Allowed out of CA by permit. Vehicles and equipment to be disinfected.
<i>Movement of table eggs</i>	Allowed into or within RA. Vehicles to be disinfected. Allowed out of RA by permit; subject to sanitisation. Vehicles and equipment to be disinfected.	Allowed into or within CA. Allowed out of CA by permit. Vehicles and equipment to be disinfected.
<i>Movement of fertile eggs</i>	Allowed into or within RA. Allowed out of RA by permit; subject to sanitisation of eggs, disinfection of equipment and vehicles, quarantine and surveillance of destination flocks.	Allowed into or within CA. Allowed out of CA by permit, subject to sanitisation of eggs. Vehicles and equipment to be disinfected.
<i>Movement of egg pulp from plants, including on-farm plants</i>	Allowed into or within RA. Allowed out of RA by permit, subject to heat treatment. ⁸ Vehicles and equipment to be disinfected.	Allowed into or within CA. Allowed out of CA under permit. Vehicles and equipment to be disinfected.
<i>Control of domestic pets and poultry</i>	All pets and poultry to be confined.	All poultry to be confined.

CA = control area; CVO = chief veterinary officer; HPAI = highly pathogenic avian influenza; LPAI = low pathogenicity avian influenza; RA = restricted area

NOTES:

- (1) This type of movement is approved, under permit, provided that the chief veterinary officer has cleared this type of movement (ie generally not each individual movement) with the Consultative Committee on Emergency Animal Diseases. Risk materials, vehicles and equipment would need to be disinfected.
- (2) If the CA contains an appropriate abattoir, permits can be issued to move meat chickens from SPs and from the RA following inspection (no birds showing clinical signs) and negative serosurveillance, for immediate slaughter (within 24 hours). The movement of the live birds requires careful selection of transport routes and disinfection of vehicles and equipment. The product from poultry will be permitted to move to approved premises outside the CA where it is subject to heat treatment sufficient to kill virus before being sold to consumers. Waste is to be subject to approved disposal.

- (3) Permits for movement of susceptible birds onto an SP or into an RA or CA should be issued with caution. Although such movements pose no risk of spreading infection, compensation would be payable if these animals were to become infected. Birds must remain on the property for at least 21 days and be inspected before any further movement, or be immediately processed.
- (5) If a processing plant has received birds from an IP or DCP since the date when they were infected or exposed to infection, the plant must be cleaned and decontaminated, under supervision, before operating again. Staff must undergo disinfection procedures before leaving the premises. Advice must be given to staff about poultry, cage and aviary birds or pigeons kept at their homes.
- (6) The vehicle must be disinfected on site, at a central point or back at the mill.
- (7) The refuse must be buried at an approved site and the vehicle cleaned and disinfected. The refuse must not be fed to or brought into contact with other birds.
- (8) Heat treatment must attain product core temperatures sufficient to kill virus before the product leaves the approved premises (see Section 1.6.2).
- (9) For the purposes of quarantine and movement controls, vaccinated birds will be treated the same as unvaccinated birds.

4.3 Criteria for permit issuance

When conducting a risk assessment regarding the issue of a permit, the officer should take into account the following:

- status of the originating and destination premises;
- species of animal;
- confidence in animal tracing and surveillance;
- destination/use of the animals or products;
- likelihood of contamination of the equipment/product/material (ability to decontaminate);
- security of transport;
- potential harbours for vectors – ability to decontaminate.

Appendix 1 Disease summary

Disease and cause

Highly pathogenic avian influenza (HPAI) is a highly contagious viral disease that can cause up to 100% mortality in poultry. The disease is caused by a subtype of influenza A virus in the Orthomyxoviridae family.

Species affected

All commercial, domestic and wild bird species are susceptible, but disease outbreaks occur more frequently in chickens and turkeys. Infection may be brought into Australia by migratory wild birds. Many species of waterfowl, especially geese, ducks and swans, carry the virus but usually show no signs of disease. Historically, humans have not been affected, but more than 150 humans have died in the current H5N1 epidemic, principally in Southeast Asian countries.

Distribution

Avian influenza (AI) viruses are probably ubiquitous throughout the world in wild waterbirds, with outbreaks of disease in poultry occurring as sporadic events. Since December 2003, there have been outbreaks of highly pathogenic H5N1 AI in poultry and other birds in Korea, Japan, Vietnam, Thailand, Cambodia, Laos, Indonesia, China and Malaysia. In 2005, H5N1 was reported in birds in Kazakhstan, Mongolia and Russia, and the disease then spread westwards into Romania, Turkey and the Ukraine. By early 2006, there were reports of H5N1 virus in wild and domestic birds in some European Union Member States, domestic birds in India, and in domestic and wild birds in the middle East (Iraq, Iran, Israel). The virus has also been reported in domestic birds in some countries in Africa (Niger, Nigeria, Egypt, Cameroon), and in Afghanistan and Myanmar. The virus has been the cause of clinical disease in commercial poultry in Australia in Victoria (1976, 1985 and 1992), Queensland (1994) and New South Wales (1997).

Key signs

The clinical signs of HPAI in birds are variable and can be affected by the existence of other diseases, the age of the birds, the environment and the virulence of the virus. In very severe forms, the disease appears suddenly and all birds may die quickly. Some may appear depressed, egg production falls and soft-shelled eggs are produced. There may be profuse watery diarrhoea, combs and wattles may become blue and respiration may be laboured. In less severe forms, the clinical signs may include decreased egg production, depression, respiratory signs suggestive of a cold, swelling of the face, nervous signs, and diarrhoea. The severity of signs can vary when the virus mutates during an outbreak.

Spread

Direct or indirect contact with migratory waterfowl (probably through drinking water) is the most likely source of HPAI infection in poultry. The virus can be isolated from lake water where waterfowl are present. Spread can also occur through contact with contaminated equipment or humans. Although the virus has been found inside the egg, transmission through the egg is not known to occur, but the shell can be contaminated. The

virus is highly concentrated in the manure and in nasal and eye discharges, and spreads more easily in winter.

Persistence of the virus

Environmental conditions have a marked effect on virus survival outside the bird. Avian influenza virus can survive for at least 35 days at 4°C in manure. The virus can survive several days in carcasses at ambient temperature and up to 23 days if they are refrigerated. Virus can persist in poultry meat products but is eliminated by adequate heating, such as cooking.

Control strategy

The strategy is to eradicate HPAI in poultry, cage and zoo birds by immediate stamping out (killing of the birds) and disposal of infected and exposed birds to remove the major source of virus. When HPAI is confirmed on a premises on which rare poultry, cage or zoo birds are present, the primary objective is eradication of the virus. A modified stamping-out approach may be appropriate, taking into account requirements for biosecurity, ongoing tracing and surveillance, and timeliness in achieving disease eradication.

The response to a finding of HPAI in wild birds will be measured, commensurate with the level of assessed risk posed to domestic and wild bird populations, and to public health.

There will also be strict quarantine and movement controls to prevent the spread of infection; decontamination to remove and reduce the virus; tracing and surveillance to locate the source of infection, locate other infected premises and determine the extent of the infection; and zoning to define infected and disease-free areas. The potential for human infection has led to greater emphasis on eradication as a public health measure.

In Australia, vaccination could be part of a response where the disease is likely to spread and is unable to be rapidly controlled by stamping out and other measures. The decision whether to vaccinate and the options chosen in Australia will be determined by factors such as the species and types of birds at risk, the density and characteristics of the surrounding avian population (wild and domesticated), geographic considerations, epidemiological factors, the virus subtypes involved, public health concerns, the resources available and the availability of appropriate vaccines.

There is potential for low pathogenicity strains (LPAI) to mutate into HPAI, so control measures will be applied if those strains are detected.

The Australian government–industry agreement for sharing the costs of emergency animal disease control applies to HPAI and to LPAI subtypes H5 and H7.

Summary of the control policies for avian influenza in Australia

An outline of the control policies for HPAI, LPAI (H5/H7) and LPAI (not H5/H7), in poultry, cage and zoo birds, and wild birds, is shown below. See Section 3 of this manual for further details of these policies.

Overall policy for avian influenza classified as HPAI (except in wild birds)

Highly pathogenic avian influenza (HPAI) is a OIE (World Organisation for Animal Health) notifiable disease (HPNAI) that is highly lethal to poultry and has the potential to infect humans. An uncontrolled outbreak of HPAI would cause severe production losses with consequent dislocation and financial losses in the poultry and associated service and sales industries. It may also lead to morbidity and mortality in large numbers of cage and zoo birds.

When the Consultative Committee on Emergency Animal Diseases (CCEAD) determines that an infection in poultry, cage or zoo birds, is caused by a virus that meets the definition of HPAI and in its view is eradicable, and this advice is endorsed by the National Management Group (NMG), the policy is to eradicate the disease in the shortest possible period, while limiting the risk of human infection and minimising economic impact, by implementing the following strategies:

- *stamping out* by destruction of all birds on infected premises (IPs) where there is clinical disease or evidence of active infection with HPAI virus, and the sanitary disposal of destroyed birds and contaminated avian products to remove the source of infection;
- possible *pre-emptive slaughter* of birds on other premises, depending on information derived from tracing, surveillance and study of the behaviour of the disease;
- *quarantine and movement controls* on birds, avian products and associated items in declared areas to prevent spread of infection (a national standstill is *not* necessary for containment of AI);
- *decontamination* of facilities, products and associated items to eliminate the virus on IPs and to prevent spread in declared areas;
- *tracing and surveillance* to determine the source and extent of infection, and to establish proof of freedom from the disease;
- *enhanced biosecurity* at poultry establishments, and premises holding cage or zoo birds;
- *zoning and compartmentalisation* to define infected and disease-free areas;
- *a public awareness campaign* to communicate risk and promote cooperation from industry, zoos, cage bird owners and the community; and
- protection of *public health*, by requiring that personnel engaged in eradication activities be vaccinated (with the currently available human vaccine), be treated with antivirals (if appropriate) and wear protective clothing.

Vaccination may be considered if an outbreak of HPAI is likely to spread or has spread out of control.

Under the *Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses* (EAD Response Agreement) for cost sharing, HPAI (H5/H7) is a Category 2 emergency animal disease (EAD) and HPAI (not H5/H7) is a Category 3 EAD. Category 2 EADs are those for which costs will be shared 80% by government and 20% by

industry; Category 3 EADs are those for which costs will be shared 50% by government and 50% by industry.

When HPAI is confirmed on or threatens to spread to premises on which rare poultry, cage or zoo birds are present, the prime objective is eradication of the virus. A modified approach, including consideration of vaccination, may be appropriate, however, taking into account factors such as biosecurity, movement controls, ongoing tracing and surveillance, and timeliness in achieving disease eradication.

3.1.2 Overall policy for avian influenza classified as LPAI (H5/H7) in poultry

Low pathogenicity avian influenza (LPAI (H5/H7)) is an infection caused by a strain of avian influenza virus that is of H5 or H7 subtype and produces mild or no clinical disease in poultry. LPAI could mutate to HPAI and cause significant disease problems in the poultry industry, and lead to morbidity and mortality in large numbers of cage and zoo birds.

Such virus strains in poultry are classified as notifiable (LPNAI) according to OIE criteria, and because of the potentially severe consequences of an uncontrolled outbreak of these strains of AI mutating to HPAI, they are categorised under the EAD Response Agreement. LPAI (H5/H7) of subtypes H5 or H7 is a Category 3 EAD under the EAD Response Agreement for cost sharing. Category 3 diseases are those for which costs will be shared 50% by government and 50% by industry.

When CCEAD determines that an infection is caused by an AI virus that meets the definition of LPAI (H5/H7), the policy is to control and eradicate the disease, while limiting spread and potential for mutation to HPAI, using a combination of strategies, including:

- *tracing and surveillance to determine the source and extent of infection and to establish proof of freedom from the disease; followed by*

either

- *stamping out either as for HPAI, if the infection is limited in distribution in the poultry industry and destruction of infected flocks is manageable or by modified stamping out using process slaughter if processing capacity is available;*

or

- *vaccination and a modified approach to eradication, if the infection is likely to spread or has spread out of control;*

and

- *quarantine and movement controls on poultry, poultry products and associated items in known IPs to prevent spread of infection;*
- *decontamination of facilities, products and associated items to eliminate the virus on IPs;*
- *enhanced biosecurity at poultry establishments and premises holding cage or zoo birds in the vicinity;*
- *zoning and compartmentalisation to define infected and disease-free areas; and*
- *a public awareness campaign to communicate risk and promote cooperation from industry and the community.*

When LPAI (H5/H7) is confirmed on or threatens to spread to a premises on which rare poultry are present, enhanced biosecurity, movement controls (such as lifetime quarantine) and ongoing tracing and surveillance will be implemented. Vaccination may be considered.

3.1.3 Overall policy for avian influenza classified as LPAI (H5/H7) in cage or zoo birds

LPAI (H5/H7) is an infection caused by a strain of avian influenza virus that is of H5 or H7 subtype and produces mild or no clinical disease. LPAI could mutate to HPAI and lead to morbidity and mortality in large numbers of cage and zoo birds.

Because of the potentially serious consequences of the spread of these strains of AI, LPAI (H5/H7) in cage or zoo birds is a Category 3 EAD.

When CCEAD determines that an infection in cage or zoo birds is caused by such a virus, an assessment of the risks to animal and public health will be carried out, taking into account the species of bird involved, the clinical status of the birds, and their proximity to commercial poultry and other significant bird establishments and populations, and to public amenity areas. The policy is to limit the spread of the infection and its potential for mutation to HPAI, and the response will depend upon the assessed risk. A combination of strategies may be employed, including:

- *tracing and surveillance to determine the source and extent of infection and to establish proof of freedom from the disease;*
- *quarantine and movement controls on birds and associated items in known IPs to prevent spread of infection;*
- *stamping out as for LPAI in poultry, or a modified approach to control in accordance with the risk assessment; this may include vaccination if the infection is likely to spread or has spread out of control;*
- *decontamination of facilities, products and associated items to eliminate the virus on IPs;*
- *enhanced biosecurity at avian establishments in the vicinity; and*
- *a public awareness campaign to communicate risk information and promote cooperation from industry, zoos, cage bird owners and the community.*

When LPAI (H5/H7) is confirmed on or threatens to spread to a premises on which rare cage or zoo birds are present, enhanced biosecurity, movement controls (including lifetime quarantine) and ongoing tracing and surveillance will be implemented. Vaccination may be considered.

3.1.4 Overall policy for avian influenza infections classified as LPAI (not H5/H7) in poultry, or in cage or zoo birds

Avian influenza caused by a strain of virus that is neither HPAI nor LPAI subtype H5 or H7, and which is producing no or mild clinical disease, is not considered an immediate threat to Australia's domestic or zoo birds or public health. Such AI virus strains are classified as LPAI (not H5/H7), and their detection in Australia would not be treated as an emergency disease outbreak.

When the CVO determines that an infection is caused by such a virus, an assessment of the risks to animal and public health will be carried out, taking into account the virus subtype, the species of bird involved, the clinical status of the birds, and their proximity to commercial or other significant bird establishments and populations, and to public amenity

areas. No action will be required unless the risk assessment indicates an unacceptable threat to animal or public health. When a response is necessary, it may include:

- *tracing and surveillance to determine the spread of infection;*
- *enhanced biosecurity; and*
- *an industry-arranged control program.*

These AI subtype viruses (LPAI (not H5/H7)) are not categorised under the EAD Response Agreement for cost-sharing arrangements.

3.1.5 Overall policy for avian influenza infections classified as HPAI or LPAI in wild birds

Avian influenza infections classified as HPAI or LPAI in wild birds are not considered to pose an immediate threat to Australia's domestic or zoo birds, or public health. Their detection would therefore not be treated as an emergency disease outbreak in Australia. However, HPAI infections in domestic or zoo birds could have serious consequences for avian and/or public health.

Therefore, if HPAI infection is detected in wild birds, the CCEAD will be convened and an assessment of the risks to animal and public health will be carried out, taking into account the circumstances under which sampling occurred, the possible source of the virus, the species of bird involved, the clinical status of the sampled birds/population, and their proximity to commercial and other significant bird establishments and populations, and to public amenity areas.

The response to a finding of HPAI infection in wild birds will be measured, commensurate with the level of assessed risk posed to domestic and wild bird populations, and to public health. No destruction of wild birds will occur, other than for reasons such as animal welfare. For further details, see Appendix 2.

If widespread HPAI infection is found in wild birds only (ie not in poultry, cage or zoo birds), it may be necessary to proclaim restricted areas, to conduct broader surveillance and to consider the use of vaccination in domestic and zoo birds in the immediate vicinity.

If LPAI infection is detected in wild birds, no further action is required, however consideration may be given to increasing surveillance in commercial poultry and zoo birds in the immediate vicinity of the wild bird LPAI detection.

Appendix 2 Response policy for HPAI in wild birds

1. The response to a finding of HPAI in wild birds will be measured, commensurate with the level of assessed risk posed to domestic and wild bird populations, and the risk posed to the community in general.
2. Testing for AI in wild birds will be performed only in laboratories that are competent and are using appropriate methods. Testing for HPAI will be undertaken in accordance with the *Procedures for Transmission of Diagnostic Specimens for Suspect Emergency Animal Diseases* (October 2006) agreed by the Animal Health Committee, and as set out in AHC08 OOS27 *Reporting and Laboratory Testing Protocols for AI*.
3. Confirmation of HPAI infection is obtained from the isolation and typing of an HPAI virus or the detection of genetic material from an HPAI virus. Sero-evidence of H5 or H7 antibodies is not evidence of infection with HPAI and response action will not be taken based on the results of serological testing only.
4. As the opportunity for follow-up sampling and testing of individual wild birds is rarely available, sampling of wild birds for AI will include appropriate cloacal and/or tracheal samples for virus detection. Collection of serum samples only should generally be avoided given the difficulties of interpretation and the inability to collect further meaningful samples from the sampled birds at a later time.
5. At the time of sampling, all relevant details will be recorded, including date, location, species, circumstances and the clinical status of the bird(s) sampled.
6. If blood samples are all that is available, animal health authorities will consider all available information, including clinical signs, and determine the value and feasibility of further investigations, including ability to identify the target population and collect further samples.
7. Where evidence of infection with HPAI virus has been found in the situations described in the following table, the actions identified in the table will be considered. The actions implemented will be dependent on available information and the assessed risk, and will be those agreed by the CCEAD.
8. Risk assessment will include considerations of the circumstances under which sampling occurred, the possible source of the virus, the species involved, the clinical status of the sampled birds/population, the proximity to commercial and other significant bird establishments, and proximity to public amenity areas.

A. If HPAI virus is detected in a wild bird, the CVO of the state/territory of origin of the sampled bird(s) should immediately notify the Australian Chief Veterinary Officer (ACVO), who will convene a meeting of CCEAD.

CCEAD will consider the following matters in deciding upon the further action to be taken:

Actions to consider	Comments
Appropriate advice to relevant Commonwealth, state/territory health authorities.	
Where practical, timely and appropriate, commence epidemiologically based investigations in the area where the bird was found:	
– Consult as necessary with expert group (eg ornithologists) to consider ecology of the avian species involved	Determine possible range of involvement
– Consider possible source of the HPAI	From the ecology of the species involved
– Consider the value of sampling live birds, and as necessary dead birds, for evidence of HPAI; sampling of dead birds may be particularly justified in the case of H5N1 HPAI	Establish protocols and determine which agency will collect samples
– what private/public enterprises holding birds are in the vicinity and identify whether any risks require managing	Including zoos and public parks
– Develop a communications strategy – Based on the findings of the risk assessment, relevant communications elements may include: <ul style="list-style-type: none"> • assurances concerning public health risks, in concert with public health authorities • advice on importance of biosecurity to bird owners, poultry producers, veterinarians • the need for vigilance by poultry and bird owners for signs of unusual disease, and the requirement for reporting to animal health authorities. 	Including the public and bird owners

B. If HPAI virus is detected in more than one wild bird in a group or area, CCEAD may further consider:

Actions to consider	Comments
Undertake actions in A	
Consider sampling of identified wild and domesticated birds	Statistically based sampling regime may be considered if practical
Provide targeted advice/warnings on biosecurity to:	
– veterinarians	
– managers of public collections	Zoos and parks
– owners of pet and aviary birds	
– owners of poultry	Backyard and all poultry industry sectors
– those with vested interest	Nature wardens, ornithologists, twitchers
– general public	
Consider necessary actions for wetlands and sanctuaries	

C. If further investigations prove widespread HPAI infection in wild birds only (ie not domestic birds) then CCEAD should consider whether further actions may be justified:

Actions to consider	Comments
Identification/proclamation of restricted or surveillance areas if appropriate, including whether controls should be applied over movement and congregation of birds and fomites (eg bird shows, pigeon races)	Only likely to be of value in exceptional circumstances, when justified by assessed risk
Appropriate surveillance measures to be applied	Based on assessed risk
Enhanced communications strategy including advice to be given to other agencies, industries, public	Including zoos and public parks
The use of vaccination	In accordance with AUSVETPLAN (eg zoos, pets, public flocks)
Consultation with health officials	Authoritative public health assurances will be essential

Appendix 3 National guidelines for the protection of people exposed to animals infected or potentially infected with avian influenza viruses with zoonotic potential in Australia

Note: These guidelines are being updated by the Australian Government Department of Health and Ageing

These guidelines are based on material developed by the World Health Organization, the United States Centers for Disease Control and Prevention, and the Australian Government departments of Agriculture, Fisheries and Forestry, and Health and Ageing.

The guidelines are intended for use by people who are in a high-risk situation at the time of a response to an outbreak of HPAI in birds in Australia.

The guidelines aim to minimise the risk of spread of virus via people and are for use in addition to normal workplace occupational health and safety (OHS) operations, including good hygiene practices. AUSVETPLAN sets out comprehensive infection control, containment and eradication procedures, including OHS advice that should be read in conjunction with these guidelines.¹⁴

It is important that both the animal/agricultural and the human health sectors work together to implement the measures below.

Before participating in the response, personnel should be trained in the use of personal protective equipment (PPE) and procedures for dealing with sick or dead birds.

Further information on the protection of people potentially exposed to AI virus is available online from the Australian Government Department of Health and Ageing.¹⁵

Vaccination

All workers who are or will be directly exposed to infected or potentially infected poultry or poultry products and waste must be vaccinated with the seasonal human influenza vaccine (that is, the human influenza vaccine that is currently available). The vaccine usually becomes available in March. Although the human influenza vaccine will not protect workers against AI, it may prevent simultaneous infection with human influenza and AI. There is a small possibility that if a person is infected with both these viruses at the same time, the viruses could share genetic material to produce a new and highly transmissible virus that would pose a threat to the wider community.

¹⁴ Available online at <http://www.animalhealthaustralia.com.au>

¹⁵ http://www.health.gov.au/internet/wcms/publishing.nsf/content/health-avian_influenza-index.htm

General advice if HPAI is diagnosed in Australian poultry

All people should avoid unnecessary contact with infected or exposed poultry and poultry products, including excreta.

Children should not have contact with infected or exposed poultry or any other affected birds.

People with weakened immune systems (from such causes as some cancers, cancer treatments or high-dose steroids), people aged over 60 years and people with known chronic heart or lung disease should avoid contact with affected birds or their environment.

Selection of personnel to work on IPs should include procedures to identify and exclude people at high risk.

It is important that personnel know the symptoms of AI infection in humans and seek medical advice if they become unwell.

Specific advice for all personnel involved in managing an outbreak of HPAI in poultry

Workers must be protected from HPAI wherever there is contact with contaminated premises, infected poultry or poultry products, including litter.

Any worker who does not agree to abide by these guidelines must not be exposed to infected poultry or contaminated areas and should be excluded from handling infected poultry or working in a contaminated environment.

All workers will undergo comprehensive decontamination, in accordance with AUSVETPLAN, following exposure to contaminated materials.

Personal protective equipment

All workers require access to appropriate PPE and instruction in its use, including respirator fit-testing. Use of PPE requires supervision.

Protective overalls should be worn and, where gross contamination of clothing is likely, an impermeable apron. Disposable protective clothing is preferred, and this clothing should be kept separate from street clothes. If nondisposable clothing is used, it should be cleaned and disinfected according to AUSVETPLAN recommendations.

Disposable gloves or rubber work gloves that can be disinfected should be worn. Gloves must be changed if they become torn or damaged.

A disposable P2 respirator of AS/NZA 1716¹⁶ standard is the minimum level of respiratory protection that should be worn. Workers should be clean-shaven and fit-tested to the model of respirator they will wear, and know how to check the face seal. A powered-air purifying respirator (PAPR) will provide a higher degree of protection during high-risk activities, such as the culling of poultry.

¹⁶ AS/NZS 1716 standard, US NIOSH certified N-95 or European CE P2

Goggles or a visor should be worn to prevent eye splash.

Disposable footwear or rubber or polyurethane boots that can be disinfected should be worn.

All disposable PPE should be disposed of according to AUSVETPLAN instructions.

Hands should be washed thoroughly after PPE is removed.

Reusable items such as rubber gloves, boots and PAPRs should be cleaned and disinfected according to AUSVETPLAN recommendations. AI virus is susceptible to detergents and to a range of disinfectant products.

After cleaning and disinfection, PPE should be stored in a clean place to avoid contamination.

Antiviral drugs

Antiviral drugs are recommended for workers in direct contact with infected poultry or contaminated materials for the duration of their exposure and for seven days after their last exposure.¹⁷

Public health authorities will provide the drug of choice and product use and safety information, and arrange supervised dosing of antiviral medications daily at the workplace.

Antivirals should not be taken for more than 42 days.¹⁸ If the exposure period (culling and clean-up) will be prolonged, personnel should be rotated off site.

Health surveillance of workers

Workers should monitor their health, watching for signs of fever, respiratory symptoms (eg cough) and conjunctivitis (eye infections) during exposure to infected birds or contaminated environments and for one week after the last exposure.

Workers who develop any of these symptoms should seek medical advice, indicating that they may have been exposed to AI. In addition, workers should report their illness to health and safety officials at the workplace, who in turn should notify public health authorities.

Workers who are unwell should stay at home until 24 hours after any fever resolves, or until given a medical clearance.

If any worker becomes unwell, close contacts (eg household members) will be contacted by public health authorities and advised according to public health management protocols.¹⁹ Household members should also monitor their health, although transmission from person to person is extremely rare.

¹⁷ This duration is subject to revision.

¹⁸ This is based on limited data, and is subject to revision.

¹⁹ Available at http://www.health.gov.au/internet/wcms/publishing.nsf/content/health-avian_influenza-index.htm

Serological testing may be arranged for people who are exposed to potentially infected poultry. This involves testing the blood for evidence of exposure to the AI virus. The purpose of this would be to provide public health authorities with more information about the disease in humans.

Glossary

ANEMIS	<i>Animal Health Emergency Information System.</i> A system for the collection, assimilation, actioning and dissemination of essential disease control information using paper documentation and a computer database.
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 of Australia and New Zealand (PIMC)
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Australian Chief Veterinary Officer	The nominated senior Australian government veterinarian in the 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
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with OIE guidelines, based on applied biosecurity measures and surveillance, in order to facilitate disease control and/or trade.

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 epidemic 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> Section 4 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
Critical date	The earliest time the pathogen entered the premises. The critical date is determined by the CVO in consultation with laboratory staff and epidemiologists and should be consistent with the apparent incubation period of the current outbreak.
Cyanosis (adj: cyanotic)	Blueness of the skin and/or mucous membranes due to insufficient oxygenation of the blood.
Dangerous contact animal	An animal showing no clinical signs of disease but which, by reason of its probable exposure to disease (revealed by tracing and epidemiological investigation), will be subjected to disease control measures (which may require slaughter of some or all such animals). <i>See also</i> Suspect animal.
Dangerous contact premises	Premises that contain dangerous contact animals or other serious contacts. <i>See</i> Section 4 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> Section 4 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 kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888 .
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
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.
Ecchymotic haemorrhages	Small round spots or purplish discolouration caused by bleeding or bruising in the skin or mucous membrane.
Egg marketing premises	Premises where table eggs are graded and packed for the retail market. The premises may also contain a pulp plant and facilities for manufacture of egg-based products.
Egg pulp	A homogenous liquid made from either whole liquid egg, egg albumen or egg yolk, pasteurised for marketing as a liquid or frozen product.
ELISA	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.
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.
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

Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. <i>See also</i> Veterinary investigation
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.
Further processing plant	A plant that receives fresh carcasses from an abattoir for cutting up, processing into poultry nuggets, rolls, etc and cooking or partial cooking for fast-food outlets and retail markets.
Galliformes (adj: gallinaceous)	The order of birds that includes poultry, turkey, pheasant and peafowl.
Haemagglutination	Agglutination of red blood cells by a specific antibody or other substance.
Haemagglutinin (vb: haemagglutinate)	Protein on the virus surface that agglutinates red blood cells.
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of 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> Section 4 for further details
Integrator	An individual or party who owns poultry on two or more sites and usually owns feed mills and processing plants.
Local disease control centre (LDCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.

Modified stamping out	The process where stamping out is not implemented in full (eg the animals may be sent for process slaughter over a period of time, or some animals may be vaccinated, held under an appropriate level of biosecurity and killed at a later date). Details of the modifications should be provided. <i>See also</i> Process slaughter
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	<i>See</i> Wild animals
OIE Terrestrial Code	<i>OIE Terrestrial Animal Health Code</i> . Reviewed annually at the OIE General Session 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 Standards for 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).
Pathogenicity	The competence of an infectious agent to produce disease in the host species. The relative disease changes are described as highly, mildly or lowly pathogenic. Nonpathogenic describes the situation where infection produces no disease or clinical signs in a susceptible host. <i>See also</i> Virulence.
Peracute	Extremely acute form of a disease.
Petechial haemorrhage	Tiny, flat, red or purple spots in the skin or mucous membrane caused by bleeding from small blood vessels.

Polymerase chain reaction (PCR)	A method of amplifying and analysing DNA sequences that can be used to detect the presence of virus DNA or mRNA (using reverse transcriptase, or RT-PCR). <i>See also</i> Real-time PCR
Poultry	Defined by the OIE as 'all domesticated birds used for the production of meat or eggs for consumption, for the production of other commercial products, for restocking supplies of game, or for breeding these categories of birds'.
Poultry byproducts	<i>See</i> Animal byproducts.
Poultry products	<i>See</i> Animal products.
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.
Pre-emptive slaughter	Destruction of animals at high risk of infection but in which infection has not yet been demonstrated.
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
Process slaughter	The transportation of animals, under movement controls, to a processing plant and their slaughter for human consumption.
Processing plant	An abattoir for slaughtering animals for human consumption, with chilled and frozen storage facilities.
Proventriculus	The front (thin-walled) part of the stomach in birds.
Psittaciformes (adj: psittacine)	Parrots and related groups of birds.
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</i> Section 4 for further details

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, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots.
Salvage	Recovery of some (but not full) market value by treatment and use of products, according to disease circumstances.
Sanitisation	Decontamination of food products and surfaces that have direct contact with food. Disinfectants and methods approved for food products must be used.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. <i>See also</i> Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	Appearance in the blood serum of antibodies following vaccination or natural exposure to a disease agent (determined by a serology test).
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Specificity	The proportion of truly negative units that are correctly identified as a negative by a test. <i>See also</i> Sensitivity
Stamping out	The process of carrying out, on confirmation of a disease outbreak, the killing of the infected animals and those suspected of being infected on the premises and, where appropriate, those on other premises which have been exposed to infection by direct or indirect contact of a kind likely to cause transmission of the pathogen. All susceptible animals, vaccinated or unvaccinated, on an infected premises should be killed and their carcasses destroyed by a method which will minimise the spread of infection. The process should be accompanied by appropriate decontamination procedures.
Standard operating procedures	Procedures developed to comply with all necessary guidelines and to accord with industry best practice.
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; for HPAI and LPAI (H5/H7), all avian species.
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 materials or things	Materials or other things suspected of being contaminated by an emergency disease agent.
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 Section 4 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.
Transudate	A passive effusion of fluid from blood vessels that does not clot outside the body.
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.
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 virus is combined with an <i>adjuvant</i> (a substance known to increase the immunogenicity of the vaccine).
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.

- naturally occurring	A naturally occurring but lowly pathogenic 'live' virus strain that has the ability to induce protective immunity.
- recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation
Virulence	The capacity of an infectious agent to produce pathological changes. The relative competencies of the disease agent to produce disease are described as highly, mildly or lowly virulent. Agents that do not produce any disease symptoms are described as nonvirulent or avirulent. <i>See also</i> Pathogenicity
Wild animals	
- native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
- feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
- exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with OIE guidelines, based on geopolitical and/or physical boundaries and surveillance, in order to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

AAHL	Australian Animal Health Laboratory
AI	avian influenza
ANEMIS	Animal Health Emergency Information System
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DIVA	differentiation of infected from vaccinated animals
EAD	emergency animal disease
ELISA	enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization
H	haemagglutinin
HPAI	highly pathogenic avian influenza
HPAI (H5/H7)	highly pathogenic avian influenza caused by virus subtypes H5 and H7
HPAI (not H5/H7)	highly pathogenic avian influenza caused by virus subtypes other than H5 and H7
HPNAI	highly pathogenic notifiable avian influenza (OIE terminology)
IP	infected premises
IVPI	intravenous pathogenicity index
LDCC	local disease control centre
LPAI	low pathogenicity avian influenza
LPAI (H5/H7)	low pathogenicity avian influenza caused by virus subtypes H5 and H7
LPAI (not H5/H7)	low pathogenicity avian influenza caused by virus subtypes other than H5 and H7
LPNAI	low pathogenicity notifiable avian influenza (OIE terminology)
N	neuraminidase antigens
NAI	notifiable avian influenza (OIE terminology)
NMG	National Management Group
OHS	occupational health and safety
OIE	World Organisation for Animal Health (formerly Office International des Epizooties)
PAPR	powered-air purifying respirator
PCR	polymerase chain reaction

PPE	personal protective equipment
ppm	parts per million
RA	restricted area
RNA	ribonucleic acid
SP	suspect premises
WHO	World Health Organization

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