

AUSTRALIAN VETERINARY EMERGENCY PLAN

# **AUSVETPLAN**

2000

## **Disease Strategy**

### **Newcastle disease**

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

**Agriculture and Resource Management Council of Australia and New Zealand**

**This Disease Strategy forms part of:**

**AUSVETPLAN 2<sup>nd</sup> Edition 2.1, 2000**

[AUSVETPLAN Edition 1.0, was published in 1991]

**This strategy will be reviewed regularly. Suggestions and recommendations for amendments should be forwarded to the AUSVETPLAN Coordinator (see Preface).**

**Record of amendments to this manual:**

Version 2.1, published August 2000, includes minor amendments to general information contained in this manual and updates the appendix dealing with the OIE International Animal Health Code for this disease.

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## PREFACE

This **Disease Strategy** for the control and eradication of **Newcastle disease** is an integral part of the **Australian Veterinary Emergency Plan**, or AUSVETPLAN (Edition 2.0). AUSVETPLAN structures and functions are described in the **Summary Document**.

This strategy sets out the disease control principles approved in February 1991 by the then Australian Agricultural Council out-of-session at meeting 135, for use in an animal health emergency caused by the introduction of Newcastle disease into Australia. The strategy has been updated and approved by the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) out-of-session in January 1996.

Newcastle disease is designated as a List A disease by the Office International des Epizooties (OIE). List A diseases are 'communicable diseases which have the potential for serious and rapid spread, irrespective of national borders; which are of serious socioeconomic or public health importance and which are of major importance in the international trade of animals and animal products'. The principles contained in this document for the diagnosis and management of an outbreak of Newcastle disease conform with the **OIE International Animal Health Code 1999** (OIE Code; see Appendix 3).

Newcastle disease (in its classical virulent form) is included in the list of diseases for which arrangements exist under the Commonwealth/States cost-sharing agreement for the eradication of certain exotic animal diseases. Information on the cost-sharing arrangements can be found in the AUSVETPLAN **Summary Document** and the **Valuation and Compensation Manual**.

Detailed instructions for the field implementation of the strategies are contained in the **Operational Procedures Manuals** and **Management Manuals**. Cross-references to strategies, manuals, and other AUSVETPLAN documents are expressed in the form:

Document Name, Section no.

For example, **Decontamination Manual, Section 3**.

In addition, *Exotic Diseases of Animals: A Field Guide for Australian Veterinarians* by W.A. Geering, A.J. Forman and M.J. Nunn, Australian Government Publishing Service, Canberra, 1995 (**Exotic Animal Diseases Field Guide**) is a source for some of the information about the aetiology, diagnosis and epidemiology of the disease and should be read in conjunction with this strategy.

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Access to the full list of AUSVETPLAN documents can be gained via the World Wide Web at the following URL: <http://www.aahc.com.au/ausvetplan/index.htm>

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# 1 NATURE OF THE DISEASE

Newcastle disease is a highly contagious, generalised viral disease of domestic poultry, cage and aviary birds, and wild birds. The disease ranges clinically from inapparent to a rapidly fatal condition characterised by gastrointestinal, respiratory and/or nervous signs.

## 1.1 Aetiology

Newcastle disease (ND) virus is an avian paramyxovirus (PMV 1) — the first of the 9 serogroups into which the avian paramyxoviruses have been divided.

The many ND virus strains vary widely in virulence and tissue tropisms. They are classified on the basis of the speed with which they kill chickens or avian embryos under defined conditions as *velogenic* (highly pathogenic), *mesogenic* (moderately pathogenic) and *lentogenic* (of low pathogenicity). Some lentogenic strains of ND virus are considered to be avirulent.

## 1.2 Susceptible species

Newcastle disease virus is infective for almost all avian species, both domestic and wild. In mammals, natural infection has been reported in man and rodents, and a variety of laboratory animals have been infected experimentally. Non-avian infections could spread the disease but their significance is not known.

### *Chickens*

- Highly susceptible to infection with ND virus, including the pigeon variant of PMV 1, and are considered the most susceptible domestic poultry (see Section 1.4.1 for clinical signs).

### *Turkeys*

- Susceptible to ND and outbreaks, usually less severe than those in chickens, can occur in turkey flocks. Effects on egg production are similar to those in chickens. Some outbreaks have resulted in high mortalities, others in leg paralysis.

### *Pigeons*

- Susceptible and the pigeon variant of PMV 1 can produce up to 80% morbidity with nervous signs and diarrhoea being the most notable clinical features.

### *Ducks and geese*

- Usually refractory to Newcastle disease although it can occur, sometimes with paralysis of legs and wings. Respiratory signs have not been reported and morbidity in outbreaks is usually less than 10%; although clinically normal, infected ducks have been found to excrete virus for more than 6 weeks.

### *Peafowl, guinea fowl, pheasants, and quail*

- All susceptible to natural ND virus infection. Except in quail, which are very susceptible, infection usually produces only mild disease but mortalities have been recorded.

*Canaries*

- Susceptible to infection, which usually produces mild or inapparent disease although 20–30% mortalities have been recorded in experimental infections in which nervous signs predominated.

*Psittacines*

- Very susceptible to ND; budgerigars are more susceptible than canaries. Nervous signs usually predominate when there is clinical disease.
- Tropical parrots form a reservoir of virulent ND virus and have been responsible for a number of introductions to United States from Latin America. Infected psittacines can excrete virus for at least one year.

*Ratites*

- In an outbreak in Israel, 13 of 46 ostriches aged 5–9 months died with typical nervous signs of Newcastle disease. The virulent Israel-67 strain of NDV was isolated (Samberg et al 1989).
- In 1993, three outbreaks occurred on ostrich farms in South Africa. The mortality rate was low and limited to a particular group or camp.

*Wild waterfowl*

- Another reservoir of ND viruses but are usually associated with avirulent ND viruses growing in the intestine.

*Humans*

- Humans exposed to ND virus may suffer headache and ‘flu’-like symptoms and can develop conjunctivitis, usually mild and persisting 1–2 days; on occasions secondary bacterial infection may cause the conjunctivitis to become quite severe which may lead to some lasting impairment of vision.
- Most infections have occurred among laboratory workers who handle the virus either in research or vaccine production laboratories. Vaccinators and individuals who eviscerate and prepare poultry for market may also become infected. Person-to-person transmission of ND virus was suspected during the 1971–72 Californian outbreak.

### 1.3 World distribution and occurrence in Australia

Strains of Newcastle disease virus are present in most countries. Pathogenic strains are absent from Australia, New Zealand and Papua New Guinea. Irian Jaya, a province of Indonesia, is the closest area to Australia where velogenic Newcastle disease is endemic. There have been three major panzootics of viscerotropic velogenic Newcastle disease (1980s the latest) since the disease first came to international attention in 1926 (Alexander 1988). The disease was first observed in Java in 1926 and later that year spread to Newcastle in England, where it was first recognised and named.

Virulent Newcastle disease has not been seen in Australia since 1932. Avirulent strains are endemic in Australia; the prototype of these strains was identified in 1966 and designated ‘V4’. The virulence of the V4 strain is so low that the strain has provided the basis for a successful ND vaccine.

### 1.4 Diagnostic criteria

[For terms not defined in the text see Glossary]

### 1.4.1 Clinical signs

The clinical signs of ND virus infection are very variable, influenced greatly by the virulence and tissue tropism of the virus, the species, age, immune status and condition of the bird, as well as external factors such as environmental and social stress, the route of exposure and the magnitude and duration of the infecting dose. Nevertheless, clinical Newcastle disease has been broadly classified into four syndromes as follows:

- *viscerotropic velogenic* (VVND) — high mortality, haemorrhagic enteritis is the predominant lesion;
- *neurotropic velogenic* — high mortality, respiratory and nervous signs predominate;
- *mesogenic* — low mortality, respiratory signs predominate;
- *lentogenic* — produces mild predominantly respiratory disease or subclinical infection.

The viruses responsible for these forms of the disease have been similarly grouped in pathotypes but these groups are not clear cut and considerable variation in clinical signs occurs within pathogroups, especially when the condition is complicated by other pathogens or environmental factors.

An outbreak in chickens may be so severe that almost all of an affected flock die within 72 hours without noticeable signs, often causing a suspicion of poisoning. In adult layers a marked drop in production may be the first sign, followed in 24–48 hours by mortality, which can reach 100%. Clinical signs noted may be:

- a sudden drop in egg production often accompanied by production of abnormal eggs (misshapen, shells soft or missing/loss of normal pigment);
- loss of appetite, fever, weakness;
- swelling and cyanosis (blueness caused by lack of oxygen) of the comb and wattles;
- watery, bile stained, distinctive bright green or bloody diarrhoea;
- respiratory signs may include increased respiratory rate, respiratory distress, coughing and a high pitched sneeze ('snick');
- nervous signs can include loss of balance, circling, backward progression and convulsive somersaulting, rhythmic spasms, stiff neck, head tremors, and wing and leg paralysis. For further details see Geering et al 1995.

### 1.4.2 Pathology

#### Gross lesions

Young chickens, or those dying from the peracute form of the disease (causing very rapid death), may not have any lesions.

Lesions in the gastrointestinal tract progressively become oedematous, haemorrhagic, necrotic and finally ulcerative. In the viscerotropic form, oedema of the interstitial tissues of the neck, especially near the thorax, may be marked. Haemorrhages occur in the trachea, corresponding to the rings of the cartilages, and in the proventriculus, gizzard, Peyer's patches, caecal tonsils and other aggregations of lymphoid tissue in the intestinal wall. Small flat, red or purple (petechial) haemorrhages may be seen on the breast muscle, heart muscle, peritoneal adipose tissue and serous linings. In the neurotropic form there is usually a severe haemorrhagic inflammation of the trachea, but it is rare to see free blood in the lumen. Haemorrhagic lesions sometimes occur in the proventriculus, but rarely in the rest of the alimentary tract. Gross lesions may not be present in birds that show only nervous signs.

### **Microscopic lesions (histopathology)**

Histologically, brain lesions are of value in diagnosis. There is neuronal degeneration, gliosis, perivascular lymphocytic infiltration and, very characteristically, hyperplasia of vascular endothelium. Necrosis of the endothelial lining of blood vessels, thrombosis, oedema and haemorrhages may be seen in all organs. There may also be pronounced oedema and cellular infiltration of the submucosa of the nasal tract and trachea, and of the lungs and air sacs (Geering et al 1995).

### **Pathogenicity**

The extreme variation in virulence between strains of ND virus, and the widespread, but variable, occurrence of the V4 strain in Australia means that the isolation of ND virus from a bird showing clinical signs of ND in this country does not confirm a diagnosis. However, experience in the United States has shown that inapparent or atypical infections may occur during the first 2–5 weeks in chicks from immune hens. An estimate of the virulence of the isolate is therefore required to differentiate between endemic non-pathogenic and exotic pathogenic strains. This is usually based on one or more of the following tests.

#### *1. Mean death time in eggs (MDT)*

The test is conducted on 10 nine-day-old chicken embryos inoculated with serial dilutions of virus. MDT is the mean time in hours for the minimal lethal dose (MLD) to kill embryos. The result is reported in 'hours to kill' and the following is a generally accepted interpretation (OIE Manual 1992).

Velogenic:	< 60 hours
Mesogenic:	60–90 hours
Lentogenic:	> 90 hours

The test is convenient but has been criticised for lack of reproducibility.

#### *2. Intracerebral pathogenicity index in day-old chicks (ICPI)*

This test is conducted on day-old specific pathogen free (SPF) chickens over eight days and is reported as a 'score' from 0 to 2. Birds are observed daily and scored 0 if normal, 1 if sick and 2 if dead. Index values for ND viruses vary from 0, (ie no clinical signs seen in any bird during the 8-day period [lentogenic]) to 2 (ie all birds dead within 24 hours [velogenic]).

#### *3. Intravenous pathogenicity index (IVPI)*

This test is conducted on six-week-old SPF chickens over a 10-day period. The result is reported as a 'score' between 0 and 3. Birds are observed daily and scored 0 if normal, 1 if sick, 2 if paralysed and 3 if dead. Lentogenic and some mesogenic strains have IVPI values of 0 whereas velogenic strains approach 3 (ie all birds dead within 24 hours).

These three conventional procedures have been widely and successfully used for a number of years. However they all suffer from imprecision, variability and poor reproducibility. Modern nucleotide sequencing and monoclonal antibody tests will form the basis of future improved pathotyping but such new techniques are still at the developmental stage and conventional tests will continue to be used for some time.

### **1.4.3 Laboratory tests**

Animal specimens should initially be sent to the State or Territory diagnostic laboratory from where they will be forwarded to the Australian Animal Health Laboratory (AAHL), Geelong for exotic

disease testing after obtaining the necessary clearance from the chief veterinary officer (CVO) of the State or Territory of the disease outbreak and informing the CVO of Victoria (for transport of the specimens to Geelong).

### Specimens required

Samples should be taken both from live, clinically affected birds and from recently dead birds. Serum, cloacal and tracheal swabs and/or fresh faeces should be taken from live birds. From dead birds, alimentary tissues (proventriculus, intestine, caecal tonsil) and respiratory tissues (trachea, lung) should be collected. For further details see Geering et al 1995.

### Transport of specimens

Fresh tissues or swab specimens in transport medium should be chilled and forwarded with frozen gel packs (Geering and Forman 1995). For further information see the **Laboratory Preparedness Manual, Section 6 and Appendix 3**.

### Laboratory diagnosis

Diagnosis is dependent on the isolation and characterisation of virus. Tests currently available at AAHL, are shown in Table 1.

A wide variety of serological tests for ND virus are available including enzyme-linked immunosorbent assays (ELISA) and haemagglutination inhibition (HI) tests. The HI test is currently the most widely used and produces very few false positive reactions with fowl sera.

Although positive serology indicates that infection with ND virus has occurred, it does not provide a reliable guide to the pathotype of the infecting virus(es). Many poultry flocks in Australia seroconvert to ND virus due to infection with lentogenic viruses. Titres following natural infection with lentogenic strains, generally range from  $2^1$  to  $2^8$ . Higher titres in a large number of birds should be viewed with suspicion.

**Table 1 Diagnostic tests currently available at AAHL for Newcastle disease**

Test	Specimen required	Test detects	Time taken to obtain result
Virus isolation and identification	tissues	virus	2–4 days
Immunohistochemistry for antigen detection	fresh and formalin fixed tissues	viral antigen	1–3 days
Haemagglutination inhibition	serum	antibody	6 hours
ELISA	serum	antibody	8 hours
Polymerase chain reaction technique	tissues	viral RNA	2 days
	virus isolate	virulence markers	3 days
Pathogenicity testing – <i>in vitro</i>	virus isolated from eggs	proteins related to virulence	7 days

## Pathogenicity testing in birds

a) mean death time in eggs	virus isolated in eggs	virulence	a) 5 days
b) intracerebral pathogenicity	virus isolated in eggs	virulence	b) 7 days
c) chorioallantoic membrane test (CAM)	CAM material from eggs in which virus has grown	virulence	c) 2 days

Source: Information provided by AAHL, 1995 [refer to AAHL for most up-to-date information].

#### 1.4.4 Differential diagnosis

ND and avian influenza (AI) of chickens and turkeys are frequently indistinguishable, on clinical and postmortem examination, from each other and from infectious laryngotracheitis, infectious bronchitis, acute pasteurellosis, salmonellosis, other paramyxovirus infections, botulism and vitamin E deficiency. Mass mortality has been reported in cage and aviary birds caused by papova virus, and in peach faced love birds caused by viral hepatitis. Poisoning may also cause mass mortality.

ND or AI should be suspected whenever sudden deaths follow severe depression, loss of appetite, nervous signs and a drastic drop in egg production with production of abnormal eggs. The likelihood of ND or AI is increased by the presence of facial subcutaneous oedema, swollen and cyanotic combs and wattles, and tiny, flat red or purple petechial haemorrhages on the internal membrane surfaces.

## 1.5 Resistance and immunity

### 1.5.1 Innate and passive immunity

There is a variation in response by different strains of chickens to ND infection. Younger birds develop clinical signs more quickly and are more severely affected, although chickens from immune hens may be protected by antibodies derived from the yolk.

### 1.5.2 Active immunity

It is likely that the birds' full range of immune mechanisms are involved in the immune response.

Cell mediated immunity can be demonstrated 2 days after infection. All ND virus strains cause an antibody response in chickens and other avian species. However, titres in cage and aviary birds following natural infection with lentogenic strains are not known. Serum antibodies can be detected in chickens 6-10 days after infection. Titres peak after 3-4 weeks and decline to undetectable levels in 8-12 months. Neutralising antibody protects chickens, chicken embryos, and cell cultures from infection. Resistant birds have high levels of circulating antibodies. Low levels of antibody may not prevent infection but can protect chickens from severe disease and mortality. It has been demonstrated that vaccinated birds without detectable antibody may survive challenge with virulent virus. This may be due to low levels of humoral antibody, interference between vaccine and challenge virus competing for cell attachment sites, cell-mediated immunity, and/or local immunity.

Resistance to ND virus infection may be provoked by prior inapparent infection with avirulent virus such as the V4 strain. Some Australian flocks are partially immune because of exposure to non-

virulent strains of the virus. It is possible that infection could be subclinical, smoulder and become widely disseminated before being diagnosed.

### 1.5.3 Vaccination

Vaccine-induced immunity is shortlived, generally lasting 8–10 weeks. To maintain adequate protection, repeated vaccinations are needed. Parental immunity also interferes with vaccine effectiveness. Vaccination programs are therefore often delayed until chickens are 1–2 weeks old.

Both attenuated ('live') and inactivated vaccines have been developed overseas and work has been done locally with the V4 strain. Table 2 is a list of the attenuated virus vaccines in use around the world.

**Table 2 Newcastle disease virus vaccine strains**

<b>Virulence</b>	<b>Vaccine type</b>
Lentogenic	V4 strain Ulster 2C
Low pathogenicity	Hitchner B1 Asplin F strain La Sota
Mesogenic	Roakin strain Mukteswar strain Komarov K strain

Oil-based, inactivated vaccines have been prepared and are usually injected intramuscularly, whereas attenuated vaccines are generally administered by eyedrop, in drinking water, by aerosol or intranasally. A pelleted form of vaccine using the V4 strain is being developed for feeding to village chickens in countries where these constitute a significant proportion of poultry production.

Mesogenic strains would not be considered for use in Australia because the vaccine virus is capable of causing serious disease in fully susceptible poultry. Vaccines based on lentogenic strains of virus such as B1, La Sota, F and V4, which have proven efficacy against VVND, have been successful in many parts of the world.

Efficacy of live virus vaccines depends on the ability of the vaccine virus to multiply in chickens. Its ability to spread from bird to bird is also important.

Oil-based inactivated vaccines have been used where ND is endemic to revaccinate laying and breeding birds previously vaccinated with a live vaccine. The double vaccination is claimed to produce a stronger and more durable immune response. Revaccination close to the point of lay, using an oil-based, inactivated vaccine is said to protect the bird for the whole of the laying period. Simultaneous use of 'living' B1 oral spray and subcutaneous oil-based inactivated vaccine, has protected chickens vaccinated as day-old chicks, for 11 weeks.

Field vaccination trials have shown that live V4 vaccine may be effectively administered en masse to Australian chickens housed under commercial conditions on litter. Aerosol vaccination provided protection against challenge with a VVND virus (Bell et al 1991). However, there are no published reports of studies that determine the rate of excretion of virulent virus by birds challenged after vaccination with V4 virus. It is known that birds vaccinated with other strains excrete virulent virus after challenge.

## 1.6 Epidemiology

### 1.6.1 Incubation period

The incubation period is generally shorter for younger birds. It is usually 2–6 days in domestic fowls, but can be up to 15 days.

The OIE Code gives a maximum incubation period, for regulatory purposes, of 21 days (see Appendix 3).

During the incubation period, the virus replicates at the site of introduction. Virus is then discharged into the bloodstream where it replicates again in the visceral organs. Another release into the bloodstream, about two days after infection, coincides with the excretion of virus via the respiratory tract and in the faeces. Clinical signs occur 24 hours later.

However, when massive airborne exposure occurs, it may result in virus replication in the respiratory system lining and immediate excretion via the respiratory tract.

### 1.6.2 Persistence of virus

#### General properties/environment

- Compared with most paramyxoviruses, Newcastle disease virus is relatively heat stable, a feature of great importance in relation to its epidemiology and control (Fenner et al 1987):
  - it remains infectious in bone marrow and muscles of slaughtered chickens for at least 6 months at  $-20^{\circ}\text{C}$  and for up to 4 months at refrigerator temperatures;
  - infectious virus may survive for months at room temperature in eggs laid by infected hens, and for over a year at  $4^{\circ}\text{C}$ ; and
  - similar survival times have been observed for virus on feathers, and virus may remain infectious for long periods in contaminated premises.
- Direct sunlight will inactivate the virus in 30 minutes (Buxton and Fraser 1977). The virus appears to be more susceptible to the action of alkali than to acid.
- The presence of lipid in the ND virus envelope is associated with a high degree of susceptibility to all disinfectants containing detergents (see Section 2.2.8).

The persistence of exotic ND virus in waterways is not known but the disease does not appear to spread as readily through contaminated water as does avian influenza. However, the potential exists for spread of virus in contaminated water.

#### Wild birds

##### *Waterfowl:*

- can excrete virus for up to 6 weeks although they are generally refractory to clinical disease (McFerran and McCracken, in press).

##### *Psittacines:*

- have been shown to excrete virus for up to a year and have been responsible for ND panzootics in various parts of the world. The potential of ND to be spread by wild psittacines to susceptible poultry should not be underestimated (Erickson et al 1977).

##### *Pigeons:*

- excrete virus in the faeces during the acute phase of the disease after infection with VVND virus but not during convalescence;

- virus persists for 4 weeks in the trachea and lungs and up to 5 weeks in the brain;
- the birds do not become inapparent carriers and excrete virus for only a relatively short time;
- pigeons experimentally infected with a lentogenic virus capable of producing mild respiratory signs and conjunctivitis 6 days later, excreted virus for 3-7 days (Videvogel and Duchatel 1986).

*Pheasants, partridges, turkeys and quail:*

- have all been involved in ND outbreaks, some of which resulted in spread of disease to domestic poultry (McFerran and McCracken, in press).

*Ratites*

- in the outbreaks of Newcastle disease in Israel and South Africa disease spread was limited to isolated groups of ostriches.

Numerous native Australian avian species have been shown to be susceptible to ND (Bain 1993; Gilchrist 1993), however they are probably not important in dissemination.

### **Live poultry**

Virus is present in most tissue secretions and excretions of acutely infected birds beginning 24 hours before clinical signs appear and continuing through the stage of clinical disease. It is generally reported that virus can be recovered from poultry for at least 7 days after infection. Virus recovery from eggs of birds vaccinated 35 days previously has been reported (Tanwane 1971).

### **Carcases**

Viable virus remains in the carcass until decomposition is well advanced. It is stable in non-putrefying tissue and organ samples or faeces if not exposed to high temperatures and has been isolated from bone marrow held for several days at 30°C (Omojola and Hanson 1986).

Birds slaughtered for meat during an outbreak can be a significant source of virus. Most body organs contain virus at some time during infection. Infectious virus has been recovered from meat after 250 days at -14°C to -20°C and from skin and bone marrow after 250 days at -4°C (Asplin 1949). In overseas outbreaks frozen meat products have been a significant means of spread especially when uncooked poultry scraps have been fed to poultry. Virus in fresh and frozen poultry meat is of concern in outbreaks. Packaging and the drip that develops during storage are also important, as both can be contaminated with virus from infected carcasses (Lancaster and Alexander 1975).

### **Meat products**

Virus can persist in poultry meat products. There is evidence that feeding of uncooked poultry offal and scraps to susceptible birds helped to spread the disease in the Melbourne outbreaks of 1930 and 1932. Agreed minimum core temperatures to kill AI and ND viruses are:

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

For further information see Appendixes 5 and 6.

Precooked products for the retail market such as roasted and smoked poultry and poultry rolls, secondary products such as poultry stock cubes, soup mixes, canned and dried pet foods are all said by industry sources to satisfy the minimum core temperature requirements (see Appendixes 5 and 6 for the guidelines on cooking poultry meats for the prevention of spread from clinically normal

viraemic birds). However, flash fried products such as further processed poultry nuggets prepared for the restaurant and fast food markets do not meet these requirements.

Insufficient data is available on the temperatures and times required to kill all strains of exotic ND virus (Arzey 1989).

### **Table eggs and egg products**

Although severely affected birds will cease to lay, eggs laid in the early phase of the outbreak could carry ND virus on the surface. The virus can penetrate cracked or intact shells or more significantly contaminate the egg fillers. The survival time on the eggs and fillers is sufficient to allow wide dissemination. Sanitising the eggs and fillers with a sanitiser containing 50–200 ppm of available chlorine, or other registered sanitisers, will eliminate the virus from clean surfaces.

Egg pulp products are another source of the virus. Current pasteurisation procedures approved by the National Food Authority are:

- whole egg: 2.5 minutes at 64.5°C
- egg yolk: 3.5 minutes at 60°C
- egg white: 9 minutes at 55.5°C While 4.5 minutes at 64°C is assumed to kill ND virus strains, 2.5 minutes at 64°C will not eliminate the risk of virus survival.

### **Fertile eggs**

ND virus has been isolated from eggs laid by infected breeding hens (Williams and Dillard 1968). Fumigation of eggs and strict hatchery hygiene should be ensured during an outbreak.

### **Poultry by-products**

Rendered meals, produced from frames (boned-out skeletons), viscera, blood, feathers, feet, heads, necks, off-cuts, 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 several minutes to more than one hour, which is sufficient to kill ND virus. However, if the procedure is not carried out properly or cooked product is subsequently contaminated by unprocessed product, ND virus could persist for several weeks. Strict supervision of trucks that collect waste products should be instituted to ensure that they are not used for transporting rendered products without prior cleaning and disinfection. The potential for aerosol spread from improperly treated waste product should not be discounted.

### **Waste products**

Waste can be any of the unwanted by-products 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 (autoclaved cultures and specimens, dead birds), farms, egg marketing establishments (unsaleable eggs, egg shells after pulping, soiled egg fillers) as well as chicken manure and litter.

In the poultry house, ND virus has been shown to survive on feathers for 255 days and in the litter for 20 days. Most of the waste would be collected by industrial waste companies or burned/buried on the site. ND virus has the potential to persist in these products and could be disseminated by vehicles that transport them.

ND virus can remain very stable in poultry faeces, which will readily contaminate people and fomites. Spread of the disease has been associated with the use of chicken manure as fertiliser (Kelly 1973).

### **Fomites**

Survival times of various ND virus strains in soil, litter, on hessian bags and feathers, demonstrate the ability of the virus to withstand environmental conditions. Survival times are dependant on environmental temperatures and relative humidity.

### **1.6.3 Modes of transmission**

Dissemination of exotic ND virus between flocks has been attributed to the movement of clinically normal but virus shedding birds (including vaccinated birds), infected poultry products and by-products, people wearing virus contaminated clothing/footwear, equipment, litter, manure, and feed containing uncooked poultry offal meal.

#### **Live birds**

- Within a flock, the main method of transmission is by inhalation of virus-laden expired air or by ingestion of drinking water or feed contaminated with nasal secretions or faeces containing virus. Coughing is not required to produce the infective aerosols that are distributed by normal air turbulence in poultry sheds.
- Transmissions of ND virus by wild birds can occur from endemic foci among wild birds to poultry or mechanically from an infected poultry premises to susceptible poultry.
- Wild waterfowl are believed to be refractory to ND but can become carriers and shed virus for a long time.
- Transmission of ND virus from aquatic birds to non-aquatic birds has not been investigated.
- Pigeons can spread ND virus by contaminating poultry feed. There are close interactions between feral pigeons, racing pigeons and urban and rural environments. Cage and aviary birds could become infected by contact with infected pigeons.

#### *Inapparent carriers*

- Virus can remain latent in the trachea and has been recovered by organ culture from the trachea of one bird 120 days after infection (Heuschele and Easterday 1970). Latent ND virus in vaccinated or non-vaccinated birds may be shed by:
  - birds that shed virus spontaneously and intermittently;
  - birds subjected to stresses, such as transport, intercurrent disease; and
  - carrier birds whose carcasses are fed to other animals in which digestive enzymes release virus from antigen-antibody complexes.
- Ducks and geese can be reservoirs of virus and ND outbreaks have occurred where a virulent virus, which did not cause clinical signs in infected geese and ducks, was transmitted to domestic poultry (Beard and Hanson 1984).
- Pools of highly virulent ND virus are thought to occur in psittacines and passerines overseas.
- ND virus has been recovered from over 25% of introduced birds quarantined in the United States. Some of these species can become carriers and some parrots have excreted virus for more than a year. Australian species may need to be considered as potential risks during an outbreak here (Bain 1993; Gilchrist 1993).

- Canaries have been reported not to become carriers (Senne 1983).

#### **Poultry products and by-products**

- ND virus can be transmitted by insufficiently-treated poultry meat products, table eggs and egg pulp products (see Section 1.6.2).
- While pelleting of feed at 80–90°C for 30 seconds is not expected to completely inactivate ND virus, pelleted feed has not been incriminated in outbreaks.

#### **Fertile eggs (vertical transmission)**

- ND virus has been isolated from eggs laid by infected hens, but embryos infected with exotic pathogenic ND die before hatching; ND virus may, however, survive the egg incubation process and be present on the shell exterior.
- Fumigation of eggs together with strict hatchery hygiene has been suggested as a means of salvaging genetic stock from uninfected eggs in an infected flock but, if this is contemplated, strict protocols will be needed along with quarantine and intensive monitoring of flocks hatched from these eggs.

#### **Fomites**

- ND virus can be spread by contaminated clothing/footwear and equipment such as crates and egg fillers.
- Rapid transport methods employed in the modern industry are capable of moving contaminated materials over long distances, often interstate, in a few hours.

#### **Windborne**

- In an outbreak in Ireland in 1973, farms were thought to have been infected by windborne spread up to 48 km from the initial case (McFerran 1988).
- Windborne spread has been reported up to 64 m but may be influenced by the volume of virus generated (Alexander, 1988).
- In Australia, windborne spread between nearby farms may be important during cold, humid, overcast weather.

#### **Vectors**

- Any animals, including flying insects that travel between infected and susceptible birds represent potential for spread by mechanical means. Flies have been reported to be capable of disseminating ND virus in outbreaks in the United States for up to 10 days.

### **1.6.4 Factors influencing transmission**

In some Australian flocks, partial immunity is provoked by natural exposure to non-pathogenic (V4 type) strains of ND virus (Spradbrow 1980). In such flocks, exotic ND could remain undetected while the virus is being excreted by infected symptomless birds. This raises the possibility of exotic ND virus spreading undetected in Australia for a period before causing a sudden, explosive and widespread epidemic. Widespread, indiscriminate vaccination could also cause this problem.

Some strains of ND spread more readily than others. V4 has been shown to spread readily in Australia. Ability to spread rapidly within a shed is desirable for a useful vaccine strain but an outbreak caused by a rapidly spreading velogenic strain would pose considerable disease control problems.

Free-flying birds can contribute to the dissemination of virus from an infected farm, and while many farms adequately exclude such vectors, some still do not. Free-range farms could potentially become infected following contact with infected wild birds.

Viability of ND virus in the atmosphere is enhanced by low temperatures, high humidity and short day length, although V4 type strains occur widely in meat chicken flocks in southeast Queensland, an area which rarely has this type of weather. The virus may not survive well in the hot and dry climate of southern States in summer.

Some of the major poultry keeping areas in Australia are closely settled and contain huge numbers of birds (3 million on one site near Sydney). Areas of high population density make rapid airborne transmission of the virus to enormous numbers of birds possible. To overcome this danger, some important breeding flocks have been duplicated and moved to locations remote from other flocks.

## **1.7 Manner and risk of introduction**

There are a number of potential avenues of entry. Smuggling of avian material is considered the most probable means of introduction, particularly pigeons and parrots that have shown the potential to be nonclinical carriers.

A second course is for the disease to spread from Indonesia into Papua New Guinea and so on to Australia. A third potential source is through migratory wild birds. There is also the potential for contaminated refuse from international transport, but this is considered to be a low-risk source as swill feeding to commercial poultry is practically non-existent (Geering 1990).

## 2 PRINCIPLES OF CONTROL AND ERADICATION

### 2.1 Introduction

Newcastle disease virus causes a wide range of clinical conditions in domestic poultry, cage and aviary birds and wild birds. Many of the clinical syndromes mimic those seen in other conditions and in particular may be indistinguishable from avian influenza. ND virus is stable under a wide range of environmental conditions allowing it to be spread very easily from flock to flock directly and via fomites or by more complex pathways such as faecal contamination of processed poultry feed. The basis of eradication of ND in Australia will be the rapid imposition of effective quarantine on all birds on which any degree of suspicion may fall, the elimination of the pathogen where it is known to have been present and prevention of movement of known and suspected contaminated materials. Key factors in achieving these objectives will be rapid reporting and diagnosis together with swift imposition of effective movement controls.

### 2.2 Methods to prevent spread and eliminate pathogens

The present policy for ND is to eradicate the disease as soon as it is confirmed. The fundamental method by which this may be achieved is the immediate isolation of infected birds followed as rapidly as possible by slaughter and sanitary disposal of carcasses. It will also involve control or destruction of other animals or birds that could transmit the disease as well as thorough cleaning and decontamination of the infected sites.

#### 2.2.1 Quarantine and movement controls

Overseas experience has shown that Newcastle disease 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. As ND is very readily transmitted via fomites, strict control of movement of anything that may have become contaminated with virus and immediate imposition of tightly controlled quarantine on all places suspected of being infected, is essential to a successful eradication program. Quarantine should be imposed on all farms on which infection is either known or suspected and should be strictly policed to ensure that no-one, including the owners, their friends and staff, leaves without changing clothes and footwear. Service vehicles on the premises at the time quarantine is imposed must be disinfected as they leave the premises. Although the evidence is largely circumstantial, free flying birds are believed to have been vectors in outbreaks overseas and removal of potentially-infected backyard flocks of poultry and birds such as pigeons reduces this possibility.

#### **Infected premises, dangerous contact premises and suspect premises**

Quarantine of an infected premises prevents spread of the disease from the property by prohibiting movement of birds, products and materials to or from the property. It is important to apply quarantine measures as early as possible to slow the rate of spread in an area. Detailed tracings of the movement of birds, feedstuff, poultry products and wastes to and from infected premises (IPs) and dangerous contact premises (DCPs) is a foremost priority at the very beginning of an outbreak of ND. As the incubation period of ND can be up to 15 days, trace-back procedures should apply to all movements that took place during the previous 15 days. This period should be extended to 21

days to cover the possibility that the first cases were not recognised, and to be consistent with the OIE code. Quarantine measures should be applied immediately wherever there is any doubt of potential infection. Such action may result in protests but must be taken pending a full investigation/understanding of the epidemiological situation. It may well take several weeks before there can be any confidence that other properties in the area are not incubating the disease and, in this time, the strictest quarantine measures must be maintained. If possible, DCPs should be slaughtered out before the flocks excrete virulent virus.

If the restricted or control area contain an appropriate place for poultry slaughter, strong consideration should be given to permitting meat chickens of suitable size from suspect premises (SPs), where no sign of infection has developed during the declared incubation period, to be removed for supervised slaughter for human consumption. This represents a minimum risk of infected birds being removed, a risk that is further reduced by the cooking processes involved in the human food chain. If properly managed, this risk would be highly preferable to the virus ‘factory’ that would result from the development of clinical disease.

Effective quarantine of a premises will require security to be maintained around the clock to ensure that only authorised personnel, in protective clothing, are allowed to enter. It will be necessary to limit and supervise the movements of residents onto and off the property and to ensure that all pets are confined.

### **Restricted areas and control areas**

The declaration of a restricted area (RA), which should include the IPs and as many of the DCPs and SPs as possible, assists the prevention of spread by restricting movements on and off premises that have had direct or indirect contact with infection. However, movement controls in the RA should not hinder the movements of the general public.

The RA 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 and will generally be in the order of 1–5 km. The boundary will be fixed to take account of the distribution of susceptible birds, as well as traffic patterns to markets, service areas and abattoirs, and areas that constitute barriers to movement.

The declaration of a control area (CA) helps 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 industry. The boundary does not have to be circular or parallel to that of the RA but should be generally between 2–10 km from the boundary of the RA. Movement of possibly infected birds and contaminated things and materials *within* the CA will be allowed but movement out of the CA will be prohibited without chief veterinary officer (CVO), or delegate, approval. Normal commerce should be allowed to continue as much as possible.

It may also be necessary to ban pigeon racing in the eastern States or in WA for the duration of the outbreak.

Further details on movement controls are given in Appendix 2.

### **Zoning**

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 loss suffered by the uninfected industry during an exotic disease outbreak.

It is very probable that interstate commerce involving poultry products from outside the RA, could be carried on with no real danger of disease transmission.

When the first outbreaks of the other OIE List A disease of poultry, *avian influenza* (AI), occurred in Australia (1976, 1985), the initial response was for States to close their borders until the extent of the disease was known. The later outbreaks of AI (1992, 1994) saw less reaction in this way, probably due to the experience gained from the earlier outbreaks that indicated the almost non-existent spread from the infected properties.

Consideration should be given, however, to the possibility of an outbreak that is not as easily controlled or where the incident may be occurring in an area that crosses a State border. This could more rationally be handled by declaring a zone rather than the State border as the operational boundary. Such an arrangement would need to be endorsed by the Consultative Committee on Exotic Animal Diseases (CCEAD) and be consistent with the OIE Code (see Appendix 3).

### 2.2.2 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 required 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 place and should be consistent with the maximum incubation period, designated by OIE, of 21 days.
- Movements to and from IPs and DCPs for at least 21 days before the first observation of unusual morbidity or mortality should be traced as a foremost priority.
- Movements should be traced of birds, eggs, poultry products, feed, litter, waste, equipment, and people.
- People involved with feed delivery, plus vaccinating crews, catching crews, tradespeople, company service people and veterinarians should be interviewed and lists compiled of all possible contacts for three days after visiting any premises under suspicion.
- The original source of introduction of the virus should be traced (see Section 1.7) as it could remain a threat.

### 2.2.3 Surveillance

Active surveillance should be initiated as soon as ND is confirmed. In the initial stages, at least, samples should be taken of all species of birds that die in the RA and checked for ND lesions; specimens should be submitted to approved laboratories for virus isolation. Field surveillance should seek to detect changes in flock health. Examinations can be done at least twice weekly by:

- producers carrying out their own surveillance and reporting by telephone;
- local disease control centre officers carrying out regular telephone surveillance of independent premises.

All reports of a decline in health status should be investigated. Recommended surveillance procedures are described in Appendix 4.

Although surveillance will begin immediately around the infected flock, it will have to be extended very quickly to all other sites where there has been movement of birds, products and contaminated materials might have taken place from the infected premises. It is therefore essential to trace to their

final destination all such movements that took place over a period up to 21 days before the observation of suspicious clinical findings. Information obtained from active surveillance will help to decide the extent of the RA and CA and identify the DCPs and SPs.

Surveillance of wild birds to determine their potential involvement in the dissemination of the disease may be necessary (see the **Wild Animal Control Manual, in press**).

#### **2.2.4 Treatment of infected birds**

Treatment of birds with Newcastle disease is ineffective and would not be appropriate.

#### **2.2.5 Destruction of birds**

Efficient, humane procedures must be employed to kill birds, without moving them from the site. Individual birds such as pet birds or those in aviaries are relatively easily destroyed by dislocation of the neck. Several gases have been used to kill large numbers of birds. These are: cyanide, methyl bromide, carbon dioxide, exhaust gas and nitrogen. Of these, carbon dioxide and nitrogen would be the preferred gases to use for large populations of birds (partly because of their relative lack of toxicity for humans). Whether to gas caged commercial birds in their cages depends on the nature of the buildings, the size and number of birds per cage and the time span before they are removed. It can be extremely difficult to remove dead birds from cages once rigor mortis is established. It may be better to remove such birds from their cages alive and gas them in an enclosed trailer or container before burial or incineration. Dispersal of virus by aerosol should be prevented by closing up sheds during depopulation. Access of wild birds to commercial poultry sheds and flocks should also be taken into account when deciding on the order in which to start depopulation operations. For further details see the **Destruction of Animals Manual, Section 4.7**.

#### **2.2.6 Treatment of poultry products and by-products**

Refer to Appendix 2 for allowable movements and Appendixes 5 and 6 for information on cooked products.

#### **2.2.7 Disposal**

One of the major objectives of the eradication program is prompt and effective disposal of infective material in which virus could persist, eg fresh and frozen carcasses, dead birds, eggs, litter, manure, waste products, fittings and building materials that cannot be effectively decontaminated. Available methods include burial, incineration, burning and rendering. The removal of very large numbers of birds in a short time presents environmental and logistic problems. An average shed of meat chickens close to market weight represents about 40 tonnes of organic material of which 75% is water. The disposal of litter can also pose special problems as infective virus on the surface of dry litter may cause aerosol spread when being removed for disposal. It will be necessary to moisten the surface of the litter with a disinfectant and possibly heap it in mounds, under plastic, before removal (see the **Decontamination Manual**).

Burial is the best and perhaps the cheapest option if it can be achieved at the infected site itself. Minimising the distance of transportation of infected material is desirable. However, burial at the site may not be possible because of a lack of a suitable burial site as outlined in the **Disposal Procedures Manual, Section 3.1** and arrangements may have to be made at a place remote from the infected site. A burial place outside an infected premises may be desirable in situations

where a number of infected foci would have to be depopulated and decontaminated in a given area and where a common burial site would be more efficient.

Incineration is an effective means of safe disposal of infected material. However, incinerators are generally too small to be of practical use and generally are some distance from animal facilities. Burning has been used where no burial sites are available. Because of the high water content of the carcass, burning is an expensive method of disposal. It may also be environmentally unacceptable.

Rendering is a good means of disposal if the plant has the capacity needed and if it is possible to safely and effectively decontaminate the rendering plant afterwards. Private rendering plants may not be willing to handle infected birds and eggs. Infected material would need to be transported from infected sites to the plant.

If infected material must be transported elsewhere for disposal, particular attention should be paid to eliminating factors that will contribute to 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 (for detailed information see **Disposal Procedures Manual, Section 2.2**).

### 2.2.8 Decontamination

Decontamination entails cleaning and disinfection of the infected site to remove all infective material. The cleaning of organic matter from sheds, equipment, vehicles, etc is the most important step before the actual disinfection. The quantity of disinfectant to be used in an outbreak will usually be increased several times over that used in routine disinfection procedures. Particular attention should be paid to the decontamination of litter. As the ND virus can survive up to 20 days in faecal material, it is necessary to quickly disinfect the surface of the litter and adopt measures such as composting for thermal inactivation of the virus to take place. As most disinfectants are inactivated by organic material, contaminated litter may have to be buried or burned after surface disinfection.

Equipment and fixtures should be dismantled, hand-washed and disinfected rather than cleaned and disinfected *in situ* by use of high pressure water or steam hoses. Fomites such as clothing, footwear, crates, feed sacks and egg fillers should also be disinfected if possible, or destroyed.

Decontamination of sheds, yards, poultry products, rendering plants, their surroundings and burial and burning grounds must be instituted as soon as possible.

In general, the alkalis (sodium carbonate, sodium hydroxide), the halogens (chlorine) and phenolic compounds (polyphenolic complex components and chlorinated phenol compounds), glutaraldehydes and Virkon are good for the disinfection of poultry houses, wooden structures, concrete surfaces, equipment and vehicles. Aerosol application of glutaraldehydes is especially suitable for disinfecting fans and similar equipment. Formaldehyde gas should be used for decontaminating electrical equipment and the final decontamination of hatcheries; if it can be used safely. For the type, concentration, method and application of disinfectants and further information on decontamination see the **Decontamination Manual, Table 2.4, 3.11 and 4**.

### 2.2.9 Vaccination

The fundamental method by which eradication may be achieved is the immediate isolation of infected birds followed as rapidly as possible by slaughter and sanitary disposal of carcasses. However, under some circumstances it will be necessary to also use vaccination. The epidemiological considerations that could apply over the vast range of possible outbreak scenarios mean that

decisions on vaccine use would need to be made after consideration of the circumstances prevailing at the time.

The strategic objectives of vaccination as part of an eradication campaign would be:

- reduction of virus production in large populations of poultry in which slaughter is delayed by shortage of resources;
- provision of a barrier of immune birds to assist in area containment (the ability of V4 and other lentogenic strains to do this are untested); and
- protection of particularly valuable or genetically important populations of birds (V4 vaccine has been shown to protect Australian strains of meat chickens against exotic ND in overseas tests).

If the outbreak begins in a very large poultry farm and is known to have extended rapidly to other premises in an area of very dense poultry population, it may quickly become apparent that available resources are insufficient to prevent further rapid spread using only slaughter and disposal methods. In such a case, using vaccine to reduce virus production in infected flocks or to provide a barrier of immune birds by vaccinating in a ring around the restricted area would need to be considered.

If the aim is to establish a ring of vaccinated flocks, then the outer edge of the ring should be put in place first, in case the virus had already spread further than expected. If the aim is to protect valuable flocks, then these should be vaccinated first. Vaccinating flocks from the perimeter to the centre of a zone would allow vaccination teams to move from low risk to high risk flocks, thereby reducing the chance of them inadvertently spreading the virulent virus (as happened in California in 1972).

However, if an outbreak begins in an area of generally low bird density, even though on a very large farm, it would probably be practicable and more desirable to prevent spread and eradicate the disease using only quarantine and slaughter.

If vaccination is to become part of an eradication strategy, it will be subject to the following conditions.

- The decision to use vaccine will rest with the CVO of the affected State/Territory and the Consultative Committee on Exotic Animal Diseases (CCEAD) in consultation with industry; vaccination should give priority to the biggest farms.
- Decisions on which flocks to require vaccination, and when, will be made by the CVO of the affected State.
- While the cost of maintaining a vaccine stockpile is borne by the Australian Poultry Industry Association, its use will be determined and paid for under the Commonwealth/States cost-sharing agreement.
- The CVO, subject to conditions with regard to seed lot, substrate and vaccine batch testing, will encourage Australian manufacturers to immediately redirect vaccine destined for overseas markets to the local market or increase vaccine production.

Research has demonstrated that V4 vaccine is non-pathogenic and immunogenic giving protection to half the chickens as early as 7 days after aerosol application. It was also shown that V4 spreads rapidly through a flock on litter by direct contact but does not persist on the site. **As vaccinated birds will probably become infected and shed virulent virus while remaining clinically healthy, they must be kept in quarantine and slaughtered as soon as possible.**

If vaccination of genetically important 'foundation stock' is permitted, an agreed protocol for the safe removal of eggs from the farm for hatching and subsequent growing will have been established and the fate of the flock will depend upon whether or not it subsequently becomes infected. It is possible for eggs from infected birds to become infected, but such eggs suffer early embryonic death and may be removed from the incubator on candling. It is also possible to sanitise the surface of eggs to reduce ND virus contamination. However, these techniques would need extreme care.

If a vaccinated infected flock is shedding virulent virus, under the eradication strategy the flock will be destroyed and disposed of immediately. If the vaccinated flock remains uninfected and not shedding ND virus, the protocol should specify the conditions under which eggs would be removed for hatching.

Basically, the protocol will stipulate the quarantine measures that would be imposed on the farm, hatchery and brooder/growing house; the procedures for the collection and sanitising of the eggs; and the procedures to be adopted at the hatchery and at the brooder/growing house for the detection of virus or disease (see the **Poultry Enterprise Manual, Section 4.2**).

In order to gain the greatest benefit from vaccine protection of genetically important stock, it would be desirable to apply the vaccine as soon as possible after the beginning of an outbreak. This requires that all flocks to be so protected have been identified by the industry and placed on an agreed list.

### **2.2.10 Wild bird and pest control**

Wild birds that visit poultry sheds may harbour and shed ND virus. They may introduce exotic ND virus to an area and have been implicated as the initial cause of ND outbreaks. However, wild birds appear to play little part in the spread of disease between flocks during an epidemic.

It is desirable to bird-proof the quarantined poultry houses and contaminated sites while eradication procedures are being instituted. The control and destruction of rats and mice is also important.

#### **Other birds**

After notification of a suspected outbreak, it may be necessary to ban pigeon racing activities, bird shows, local sales and markets in the RA and CA because racing pigeons have been a serious source of virus in other countries.

Particular attention must be paid to workers on infected premises who keep backyard poultry at home. It is advisable to destroy such birds as soon as possible even though they may be ornamental or pets. Pet birds linked to DCPs and SPs should be quarantined and kept under surveillance.

(For further information, see **Wild Animal Control Manual**).

### **2.2.11 Vector control**

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

### **2.2.12 Sentinel and restocking measures**

No repopulation can take place until at least 21 days after satisfactory cleaning and disinfection has been completed. Experience in the United States has shown that dead-bird sampling of repopulated sheds is more satisfactory for monitoring than placing sentinel birds in the buildings from the period of depopulation to repopulation.

### **2.2.13 Public awareness**

A media campaign must emphasise the importance of producers inspecting susceptible animals regularly and of reporting suspicious lesions and unusual deaths promptly (see Appendix 4). Details of any imposed movement controls needs to be readily available and clearly explained to industry. The public must not be panicked into avoiding poultry products. Although human infection can occur there is no risk to the general public (see Section 1.2).

## **2.3 Feasibility of control in Australia**

A number of other countries have controlled and then eradicated velogenic Newcastle disease. Using similar policies, it is feasible for Australia to attempt to eradicate an outbreak of Newcastle disease. The extent of the task and how long it might take will depend on the circumstances at the time, eg the virus type, its means of spread and whether vaccine is being used to slow the lateral spread of the virus.

### 3 POLICY AND RATIONALE

#### 3.1 Overall policy for Newcastle disease

Newcastle disease (ND) is an OIE List A disease that has the potential for rapid spread and which is important in the export, import and domestic trade in poultry, other birds and their products.

The policy is to eradicate virulent ND in the shortest possible period while limiting economic impact using a combination of strategies including:

- ☞ *stamping out*, which involves quarantine, slaughter of all infected and exposed susceptible birds on infected premises and sanitary disposal of destroyed birds and contaminated avian products, to remove the source of infection;
- ☞ *quarantine and movement controls* on birds, avian products and things in declared areas to prevent spread of infection;
- ☞ *decontamination* of facilities, products and things to eliminate the virus on infected premises and to prevent spread in declared areas;
- ☞ *tracing and surveillance* to determine the source and extent of infection and to provide proof of freedom from the disease;
- ☞ *zoning* to define infected and disease-free areas;
- ☞ *a public awareness campaign* to facilitate cooperation from industry and the community; and
- ☞ *vaccination* may be approved in special circumstances under the strict control of the chief veterinary officer.

An uncontrolled outbreak of virulent ND would cause severe production losses with consequent dislocation and financial losses in the poultry industry and associated service and sales industries. It will therefore be necessary to act immediately and effectively to control and then eradicate the disease.

There are low virulence strains of ND already in Australian poultry flocks that cause no economic loss. ND virus isolates need to be pathotyped to define their virulence.

ND (in its classical virulent form) is included in the Commonwealth/States cost-sharing agreement.

The CVO(s) in the State(s)/Territory(s) in which the outbreak(s) occurs will be responsible for implementing disease control measures (in accordance with relevant legislation), and will make ongoing decisions on follow-up disease control measures in consultation with the Consultative Committee on Exotic Animal Diseases (CCEAD), the State/Territory and Commonwealth governments, and representatives of the affected industries. The detailed control measures adopted will be determined using the principles of control and eradication (Section 2) and epidemiological information about the outbreak. For further information on the responsibilities of the State/Territory disease control headquarters and local disease control centre(s), see the **Control Centres Management Manual, Part 1, Sections 3 and 4**.

## 3.2 Strategy for control and eradication

The objective is to eradicate the disease and to establish Australia's Newcastle disease-free status in the shortest possible time. This will be achieved by a stamping-out policy with the maintenance of strict quarantine and movement controls to reduce the spread of the disease, detailed and targeted surveillance and monitoring programs to determine the presence and distribution of the disease, the disposal of infected and contaminated products and things as necessary, and intensive decontamination.

It is possible that the use of vaccine may be considered under some circumstances in order to contain the disease or slow down its spread, or to enable the salvage of valuable genetic stock.

Regular liaison and communication with the poultry industry, media and the public will be essential.

### 3.2.1 Stamping out

All birds on IP(s) will be subject to stamping out. Decisions on the destruction of birds on other premises (including DCPs) will be based on the information that becomes available from the tracing, surveillance and pathotyping that will be undertaken. Note that the AUSVETPLAN definition of an infected premises is a defined area which may be all or part of a property.

### 3.2.2 Quarantine and movement controls

There will be a declaration of infected premises (IPs), and any dangerous contact premises (DCPs) or suspect premises (SPs). This will be supported by the declaration of two major disease control areas:

- A **restricted area (RA)**, which will have a radius of 1–5 km around an infected premises and contain as many DCPs and SPs as possible, and wherever possible will exclude major markets, processing plants and general service areas. More than one RA may be declared.
- A **control area (CA)**, which should have a boundary no closer to the RA boundary than about 2–10 km, will form a buffer between the infected and free areas. This will assist in containing the disease within the RA and will enable a level of restrictions and a reasonable level of commercial activity to continue.

The initial outer boundary of the CA may correspond with State or other geopolitical borders but this boundary should be amended on the basis of the epidemiological information obtained over time to enable as much normal commercial activity as possible, in line with the accepted disease control measures. There will be varying levels of quarantine and movement control imposed on different premises within the RA.

IPs and DCPs will be subjected to strict quarantine, and movements of birds, products and other items will be prohibited. The movement of people and vehicles will be strictly controlled.

SPs will be subjected to movement controls on birds and things, and movement in and out will be dependent on regular monitoring, inspections and the time elapsed relative to the incubation period. Birds of marketing age may be permitted to be processed under strict quarantine and surveillance.

Disease-free properties within the RA will be subject to movement controls depending on their location, the products involved, the availability and location of hatcheries, processing and marketing establishments, and epidemiological investigations. Birds and products from free premises and SPs within the RA will be allowed to enter the CA for processing and marketing subject to monitoring, inspections and consideration of the incubation period. Birds are to be confined and bird-proofing of premises should be implemented as soon as possible.

There will generally be free movement of birds, products and things within the CA subject to permit and inspections of premises, surveillance and monitoring and an upgrading of hygienic standards at processing establishments and marketing/distribution centres. In general birds, products and things may enter the CA from the free areas but permission will be required for these to move out of the CA.

The status of premises should be regularly updated and restrictions on the movement of birds and products should be eased as circumstances permit. If flocks in a declared area are not depopulated, then the cost of keeping the birds beyond their normal market age will be substantial.

Any delays in the supply and demand for product and day-old chicks would result in massive cost impositions and enormous disruption to normal industry programs.

For further details see to Appendixes 1 and 2.

### **Zoning**

Zoning should be introduced as soon as possible after the epidemiological investigations have been completed and the extent and severity of the disease has been determined. Zoning requirements must be adequate to meet international standards and OIE guidelines that require a boundary with a radius of 10 km from the centre(s) of infection in intensive livestock production areas and 50 km in extensive areas (OIE Code 1992). The size of the infected zone will approximately equate to the size of the RA and CA combined. The establishment of zoning may permit earlier access to international markets from the free area.

### **3.2.3 Treatment of infected birds**

Treatment of birds for ND is not appropriate and is ineffective.

### **3.2.4 Treatment of poultry products and by-products**

The treatment of poultry products may be required in certain circumstances. The treatment imposed will depend on the type of product, the nature of the declared area and the disease status of the premises. Stored and frozen products from SPs will not require treatment if the proper sanitation procedures have been implemented, and the premises has met flock inspection requirements, demonstrated negative serology and the minimum incubation period has elapsed. All waste material must be decontaminated.

Cooked products from all sources, except IPs and DCPs, may be distributed for general commercial trade provided the products have met minimum time/temperature requirements during

cooking. Care should be taken with flash fried products (eg nuggets for further cooking) that would not have met these minimum requirements.

For further information see Appendixes 1, 5 and 6.

### **3.2.5 Vaccination**

Vaccination may be approved for use in specified flocks under strict control of the CVO. A suitable vaccine produced from a lentogenic strain may be used to reduce the volume of virus in an infected flock before stamping out when resources are limited, or to establish a barrier of immune birds around an outbreak. Vaccinated flocks must be identified.

Where vaccine is used to establish a buffer of immune birds and the birds or premises do not become infected, the birds may be slaughtered and permitted to be marketed under controlled arrangements after a suitable time has elapsed.

Approval to vaccinate genetically important foundation stock, which have been nominated by industry, may occur when prior agreement has been reached with the veterinary administrators. Agreed protocols for the collection and handling of fertile eggs need to have been developed. Vaccinated flocks remain in lifelong quarantine. If there is any evidence of infection with virulent NDV, they are destroyed. If not, they may be processed as usual at the end of their commercial life.

### **3.2.6 Tracing and surveillance**

Trace-back and trace-forward will commence immediately ND is suspected and include birds, products, feed, litter, waste, equipment and people. Trace-back will determine movements onto the premises and their origin up to 21 days before the earliest time mortality and morbidity was observed on the premises, consistent with the incubation period. Tracing will locate additional IPs and identify DCPs and SPs. The original source of introduction of the virus should be traced as it could remain a threat.

Surveillance will commence as soon as ND is suspected in order to establish the extent of the RA and CA. See Section 2.2.3 and Appendix 4 for details, including interpretation of serological results.

### **3.2.7 Decontamination**

The virus is susceptible to a wide range of disinfectants. Cleaning and disinfection of premises, things and people is an essential part of the stamping-out policy and must be rigorously applied. This should include rodent and insect control.

## **3.3 Social and economic effects**

The Australian Bureau of Agriculture and Resource Economics (ABARE) has estimated the gross value of production of the Australian egg industry at \$284 million and the chicken meat industry at \$845 million (1993/4).

The main losses will be from mortalities, which can be high, and losses due to decreased egg and meat production and reduced productivity. There will be further loss of income for an extended period due to the stamping-out policy. The disruption to the flow of product and decreased

production may cause job losses on farms, and in service and associated industries depending on 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. An uncontrolled outbreak will markedly increase production costs due to the impact of the disease and the need for ongoing control measures.

Infection in grandparent and foundation flocks will cause loss of some valuable genetic material.

The presence of the disease is likely to result in the ceasing of all exports in the short term with, perhaps, a recommencement of exports from free areas after a period of review by, and negotiations with, trading partners.

The control measures will result in disruption to breeding and production programs and the supply and movement of birds and products to producers, processors and the public. Decision makers should be mindful of the need to constantly review movement controls and restrictions to reduce the effects on production and marketing systems where possible.

Other enterprises such as pet shops and exotic bird traders will be affected by the control measures adopted.

### **3.4 Criteria for proof of freedom**

The 1999 OIE Code states that a country may be considered free from ND when the disease has not been present for at least three years. If the disease appears in a free country where an eradication policy is practised, with or without vaccination against ND, a period of at least six months must elapse after the occurrence of the last case before the country can be declared free again (see Appendix 3).

In Australia, vaccination will only be an adjunct to the stamping-out policy in association with other measures.

Adequate surveillance will need to be implemented, commencing as soon as depopulation is finalised, and will involve serological testing, clinical observation and dead-bird sampling of repopulated sheds as well as wider sampling in the CA and free areas.

Total repopulation 30 days after depopulation, with dead bird sampling, is preferred to the use of sentinel bird restocking and surveillance between depopulation and total repopulation. Seropositive flocks will require further investigation and virus isolation attempts. Appendix 4 provides a guide to the extent of surveillance and serological testing that may be necessary.

### **3.5 Funding and compensation**

Newcastle disease is included in the list of diseases for which arrangements exist under the Commonwealth/States cost-sharing agreement for the eradication of certain exotic animal diseases. Information on the cost-sharing arrangements can be found in the AUSVETPLAN **Valuation and Compensation Manual** and the **Summary Document, Appendix 3**.

### **3.6 Strategy if the disease becomes established**

In the event of widespread foci of ND there are three strategic options:

- continue stamping out;
- stamping out with vaccination; and
- vaccination.

If the number of foci exceeds the resources to stamp out, or the primary strategy is failing, one of the above options will need to be considered in close consultation with industry. **All strategy options will still have eradication as the ultimate objective.**

The major issue of concern is that obtaining ND-free status will be prolonged and the costs and losses will be high. If vaccination alone is to be used then this may affect the funding arrangements under the cost-sharing agreement and producers themselves may need to meet the costs and losses.

Whatever option is selected under this scenario there will be a need for constant liaison with industry, the media and the public together with a detailed education program and advice to producers on the disease, the control options and the best methods of handling the situation including:

- means of prevention of infection, eg water treatment, bird-proofing, pest control, isolation, hygienic practices;
- disease monitoring and flock examinations and rapid reporting of unusual events.

Any one of these options will result in prolonged losses to the poultry industry including the ancillary service and sales sections.

The acceptance of zoning may be an important factor in selecting one of the above options.

## APPENDIX 1 Guidelines for classifying declared areas

### Infected premises (IP)

A premises classified as an IP will be a defined area (which may be all or part of a property) in which a Newcastle disease or exotic virulent Newcastle disease virus exists, or is believed to exist. An infected premises is subject to quarantine served by notice and to eradication or control procedures.

### Dangerous contact premises (DCP)

Premises classified as DCPs will be those that contain birds, poultry products, poultry waste or things that have recently been introduced from an IP (usually up to 21 days before declaration of the premises being infected) and are likely to be infected or contaminated or any of these items that may have been in substantial contact with people that have been associated with an infected premises within three days of visiting the DCP. A DCP is subject to disease control procedures.

### Suspect premises (SP)

Premises classified as SPs may contain birds that have possibly been exposed to a Newcastle disease virus, such that quarantine and surveillance, but not pre-emptive slaughter, are warranted; OR birds not known to have been exposed to a Newcastle disease virus but showing clinical signs requiring differential diagnosis.

### Restricted area (RA)

An RA will be a relatively small declared area (compared to a *control area*) around infected premises that is subject to intense surveillance and movement controls. Movement out of the area will, in general, be prohibited, while movement into the area would only be by permit. 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 in the order of 1–5 km around the IP, depending on the density of 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 and traffic patterns to markets, service areas, abattoirs and areas that constitute natural barriers to movement. If possible hatcheries should be kept out of the RA.

### Control area (CA)

The CA will be a larger declared area around the RA(s) and, initially, possibly as large as a State where restrictions will reduce the risk of disease spreading from the RA(s). The boundary of the CA will be altered as confidence about the extent of the outbreak becomes clearer but must remain consistent with the OIE Code. In general, surveillance and movement controls will be less intense and animals and products may be permitted to move under permit from the area.

The declaration of a CA also helps 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 industry. The boundary does not have to be circular or parallel to that of the RA but should be 2-10 km from the boundary of the RA.

If the CA contains an appropriate place for poultry slaughter, permission should be given to remove meat chickens from 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. This represents a minimum risk of infected birds being removed, a risk that is further reduced by the

cooking processes involved in the food chain. If movement is carried out with strict supervision of quarantine and hygiene procedures, this risk would be highly preferable to the virus 'factory' that would result from the development of clinical disease.

**NB When declaring RAs and CAs, the areas must not be larger than necessary, thus restricting the number of properties to be quarantined to only those deemed prudent. If flocks in a quarantine area are not depopulated, then the cost of keeping the birds beyond their normal market age could be substantial.**

### **International considerations**

Under OIE definitions an *infected zone* means a clearly defined territory in which a disease (listed in the *Code*) has been diagnosed. This area must be clearly defined and decreed by the veterinary authorities in accordance with the environment, the different ecological and geographical factors as well as all the epidemiological factors and the type of husbandry being practised. The territory in question should have a radius from the centre or centres of the disease of at least 10 km, in areas with intensive livestock raising, and 50 km, in areas where extensive livestock raising is practised.

In June 1993 the European Union published a decision laying down the criteria for classifying Third Countries with regard to avian influenza and Newcastle disease. Annex C point 4 of this decision states:

Around confirmed outbreaks of disease a protection zone with a minimum radius of 3 km and a surveillance zone with a minimum radius of 10 km shall be implemented. In these zones stand still measures and controlled movements of poultry shall be in force until at least 21 days after the end of disinfection operations on the infected holding. Before lifting the measures in these zones the authorities shall carry out the necessary inquiries and sampling of the poultry holdings to confirm that disease is no longer present in the area concerned.

## APPENDIX 2 Recommended quarantine and movement controls

### Infected premises and dangerous contact premises

#### *Movement out of birds:*

Prohibited. All birds on an infected premises are to be slaughtered on-farm. Rapid assessment and intense surveillance of DCPs will decide whether either birds will be destroyed or the premises be treated as 'suspect'.

#### *Movement in of susceptible birds:*

Prohibited.

#### *Movement out of other animals:*

Prohibited.

#### *Movement out of litter and manure*

Prohibited

#### *Movement out of equipment and feed*

Prohibited except by permit (5)

#### *Movement in and out of people:*

Allowed by permit. Subject to strict quarantine and disinfection procedures.

#### *Movement in and out of vehicles:*

Subject to the security arrangements in place at the premises.

#### *Movement of fertile eggs:*

Prohibited. To be destroyed on the premises. Except for salvage of genetic stock (4).

#### *Movement of table eggs:*

Prohibited. Eggs to be destroyed on the place.

#### *Movement of fresh/frozen meat from birds:*

Prohibited. Meat to be destroyed on the place or otherwise by CVO instruction.

### Suspect premises

Prohibited except by permit for immediate slaughter at an abattoir and subject to strict quarantine and disinfection procedures. Subject to intense surveillance. (1)

Allowed by permit. Subject to surveillance (2).

Allowed by permit (3).

Prohibited

Prohibited except by permit

Allowed by permit. Subject to strict quarantine and disinfection procedures.

Allowed by permit. Subject to strict quarantine and disinfection procedures.

Allowed by permit. Subject to strict quarantine, disinfection and transport procedures.

Allowed by permit. Subject to sanitising procedures.

Fresh/frozen retail sales allowed except when birds have not been inspected before slaughter. Allowed by permit to be further processed or cooked outside the RA.

*Movement in of feed:*

Allowed by permit to supply feed to remaining birds on a DCP.

Allowed by permit. Subject to strict quarantine and disinfection procedures.

*To and from hatcheries:*

Prohibited.

Movement in and out permitted provided the fertile eggs, chicks and hatchery waste are from an ND-free source and the breeding flocks are serologically monitored weekly.

*To and from processing plants:*

The plant should be cleaned and disinfected **under supervision** before operating again if the plant received birds from an IP or DCP.

The plant should be cleaned and disinfected **under supervision** before operating again if the plant received birds from an SP.

Stored fresh and frozen carcasses from an IP or DCP should be destroyed.

*Movement of abattoir waste:*

Operations suspended. Waste buried on site or removed on permit subject to strict disinfection procedures.

Allowed by permit within the RA subject to strict disinfection procedures.

*Movement out of dead birds:*

Prohibited. Dispose of on place or in RA by permit subject to strict quarantine and disinfection.

Allowed by permit within the RA.

*Movement out of horticultural and agricultural crops:*

Allowed.

Allowed.

**Restricted area****Control area***Movement out of birds:*

Prohibited.

Prohibited, except by permit (2).

*Movement in of birds:*

Movement from a free area or contiguous CA to a clean abattoir for immediate slaughter is allowed by permit. Restocking may be allowed by CVO approval.

Movement from a free area to a property or abattoir is allowed by permit.

*Movement within of birds:*

Movement to an abattoir for immediate slaughter or to a property may be allowed by permit.

Movement is allowed in the CA.

*Movement through of birds:*

Direct movement by air, road or rail may be allowed by permit, provided the origin and destination are both outside the RA and CA. If transport is delayed within the CA, the birds should be regarded as suspect and their further movement reassessed.

Allowed.

*Movement out of litter and manure*

Prohibited.

Prohibited, except by permit.

*Movement out of equipment and feed*

Allowed by permit (5).

Allowed.

*To and from hatcheries:*

If at all possible hatcheries should be kept out of declared RAs. Activities will be suspended.

Fertile eggs may have to be sourced from outside the CA. Permits for day-old chickens to be supplied to properties outside the CA may be required.

*To and from processing plants:*

Activities will be suspended. If at all possible processing plants should be kept out of declared RAs.

Poultry from the CA can be processed following on-farm inspection within the previous 24 hours. Equipment to be cleaned and disinfected at the end of the day.

Poultry from outside the CA can be slaughtered subject to vehicle disinfection before leaving the CA.

*Movement of meat, offal and waste from susceptible birds:*

Movement into or within the RA is allowed.

Movement into or within the CA is allowed.

Movement out of the RA is prohibited except by permit to approved premises for heat treatment.

Movement out of the CA may be allowed by permit, preferably after processing.

*Risk enterprises, eg private avian laboratories, cull hen collectors, dead bird pick-up (not processing establishments):*

Operations suspended.

May continue to operate by permit.

*Sales, shows, pigeon races, etc:*

All gatherings of susceptible birds are prohibited.

May continue to operate by permit.

*Movement of table eggs in or out other than IPs and DCPs:*

Allowed by permit subject to sanitising procedures.

Allowed into, within or out of the CA by permit. Allowed by permit into the RA.

*Movement of fertile eggs:*

Not allowed from IPs and DCPs except by permit for genetic salvage. Allowed by permit (4) subject to strict quarantine, disinfection and subsequent surveillance, and specified transport procedures.	Allowed within the CA. Allowed by permit to outside the CA, subject to upgraded hygiene procedures and subsequent surveillance.
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*Movement of egg pulp from plants including on farm plants:*

Prohibited, except by permit for heat treatment.	Allowed within the CA. Permit required to move outside the CA.
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*Control of domestic pets and poultry:*

Within the RA, all pets are to be confined or tied up and all free poultry to be confined.	As for RA.
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**NOTES:**

- (1) If the CA contains an appropriate place for poultry slaughter, permission should be given to remove meat chickens 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. This represents a minimum risk of infected birds being removed, a risk that is further reduced by the cooking processes involved in the food chain. If movement is carried out with strict supervision of quarantine and hygiene procedures, this risk should be greatly preferable to the virus 'factory' that would result from the development of clinical disease.
- (2) Permits for movement of susceptible birds on to an SP or into an RA or CA should be issued with caution. Although such movements may pose no risk of spreading infection, compensation would be payable if these animals became infected. Birds must remain on the property for at least 21 days and be inspected before any further movement.
- (3) Stock must not have had direct or indirect contact with poultry for 21 days before movement.
- (4) Fumigation of eggs together with strict hatchery hygiene has been considered as a means of salvaging genetic stock from uninfected eggs in an infected flock. Strict protocols will be needed along with quarantine and intensive monitoring of flocks hatched from these eggs.
- (5) Feed that has been exposed to susceptible birds should be prohibited from leaving the premises

## APPENDIX 3 OIE International Animal Health Code for Newcastle disease

[NB The following text is taken directly from the OIE International Health Code (1999); Chapter 2.1.15. For definitions, Appendixes, etc see the original text. The OIE Codes are amended every year in May. At the time of revision August 2000 OIE had appointed an ad hoc working group to revise the Code chapter for Newcastle Disease.]

**Preamble:** Standards for diagnostic tests and vaccines are described in the *Manual*.

### Definition

Newcastle disease is defined as an infection of birds caused by a virus of avian paramyxovirus serotype 1 (APMV-1) that meets one of the following criteria for virulence:

- a) The virus has an intracerebral pathogenicity index (ICPI) in day-old chicks (*Gallus gallus*) of 0.7 or greater.

or

- b) Multiple basic amino acids have been demonstrated in the virus (either directly or by deduction) at the C-terminus of the F2 protein and phenylalanine at residue 117, which is the N-terminus of the F1 protein. The term 'multiple basic amino acids' refers to at least three arginine or lysine residues between residues 113 and 116. Failure to demonstrate the characteristic pattern of amino acid residues as described above would require characterisation of the isolated virus by an ICPI test.

In this definition, amino acid residues are numbered from the N-terminus of the amino acid sequence deduced from the nucleotide sequence of the FO gene, 113-116 corresponds to residues -4 to -1 from the cleavage site. [*Report of the meeting of the OIE Standards Commission, 67<sup>th</sup> General session, International Committee Paris, 17-21 May 1999*]

#### Article 2.1.15.1.

For the purposes of this *Code*, the *incubation period* for Newcastle disease (ND) shall be 21 days.

#### Article 2.1.15.2.

For the purposes of this *Code*:

#### **ND free country**

A country may be considered free from ND when it has been shown that ND has not been present for at least the past 3 years.

This period shall be 6 months after the slaughter of the last affected animal for countries in which a

*stamping-out policy* is practised with or without vaccination against ND.

### **ND infected zone**

An ND infected zone shall be considered as such until at least 21 days have elapsed after the confirmation of the last *case* and the completion of a *stamping-out policy* and *disinfection* procedures, or until 6 months have elapsed after the clinical recovery or death of the last affected bird if a *stamping-out policy* was not practised.

#### Article 2.1.15.3.

*Veterinary Administrations* of ND free countries may prohibit importation or transit through their territory, from countries considered infected with ND, of the following *commodities*:

- 1) domestic and wild birds;
- 2) day-old birds;
- 3) *hatching eggs*;
- 4) semen of domestic and wild birds;
- 5) *fresh meat* of domestic and wild birds;
- 6) *meat products* of domestic and wild birds which have not been processed to ensure the destruction of the ND virus;
- 7) *products of animal origin* (from birds) *intended for use in animal feeding or for agricultural or industrial use*.

#### Article 2.1.15.4.

When importing from ND free countries, *Veterinary Administrations* should require:

##### for domestic birds

the presentation of an *international animal health certificate* attesting that the birds:

- 1) showed no clinical sign of ND on the day of shipment;
- 2) were kept in an ND free country since they were hatched or for at least the past 21 days;
- 3) have not been vaccinated against ND; or
- 4) were vaccinated against ND using a vaccine complying with the OIE standards (the nature of the vaccine used and the date of vaccination shall also be stated in the certificate).

#### Article 2.1.15.5.

When importing from ND free countries, *Veterinary Administrations* should require:

for wild birds

the presentation of an *international animal health certificate* attesting that the birds:

- 1) showed no clinical sign of ND on the day of shipment;
- 2) come from an ND free country;
- 3) were kept in a *quarantine station* since they were hatched or for at least the 21 days prior to shipment.

## Article 2.1.15.6.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for domestic birds

the presentation of an *international animal health certificate* attesting that the birds:

- 1) showed no clinical sign of ND on the day of shipment;
- 2) come from an *establishment* which is regularly inspected by the *Veterinary Authority*;
- 3) come from an *establishment* free from ND and not situated in an ND infected zone; or
- 4) were kept in a *quarantine station* since they were hatched or for the 21 days prior to shipment and were subjected to a diagnostic test for ND with negative results;
- 5) have not been vaccinated against ND; or
- 6) were vaccinated against ND using a vaccine complying with the OIE standards (the nature of the vaccine used and the date of vaccination shall also be stated in the certificate).

## Article 2.1.15.7.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for wild birds

the presentation of an *international animal health certificate* attesting that the birds:

- 1) showed no clinical sign of ND on the day of shipment;
- 2) were kept in a *quarantine station* since they were hatched or for at least the 21 days prior to shipment;
- 3) were subjected to a diagnostic test for ND with negative results before entry into quarantine.

## Article 2.1.15.8.

When importing from ND free countries, *Veterinary Administrations* should require:

for day-old birds

the presentation of an *international animal health certificate* attesting that:

- 1) the *day-old birds* come from hatcheries situated in an ND free country;
- 2) neither the *day-old birds* nor their parents have been vaccinated using a modified live virus vaccine.

Article 2.1.15.9.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for day-old birds

the presentation of an *international animal health certificate* attesting that the *day-old birds*:

- 1) come from hatcheries which are regularly inspected by the *Veterinary Authority*;
- 2) come from hatcheries free from ND and not situated in an ND infected zone;
- 3) have not been vaccinated against ND; or
- 4) were vaccinated against ND using a vaccine complying with the OIE standards (the nature of the vaccine used and the date of vaccination shall also be stated in the certificate).

Article 2.1.15.10.

When importing from ND free countries, *Veterinary Administrations* should require:

for hatching eggs

the presentation of an *international animal health certificate* attesting that the *hatching eggs* come from *establishments* or hatcheries situated in an ND free country and which are regularly inspected by the *Veterinary Authority*.

Article 2.1.15.11.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for hatching eggs

the presentation of an *international animal health certificate* attesting that the *hatching eggs*:

- 1) have been disinfected in conformity with the procedures referred to in Appendix 4.2.4.1.;

- 2) come from *establishments* or hatcheries which are regularly inspected by the *Veterinary Authority*;
- 3) come from *establishments* or hatcheries free from ND and not situated in an ND infected zone;
- 4) come from *establishments* or hatcheries in which birds were not vaccinated against ND; or
- 5) come from *establishments* or hatcheries in which birds were vaccinated against ND (the nature of the vaccine used and the date of vaccination shall also be stated in the certificate).

Article 2.1.15.12.

When importing from ND free countries, *Veterinary Administrations* should require:

for semen of domestic and wild birds

the presentation of an *international animal health certificate* attesting that the donor birds:

- 1) showed no clinical sign of ND on the day of collection of the semen;
- 2) were kept in an ND free country for not less than 21 days prior to collection.

Article 2.1.15.13.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for semen of domestic and wild birds

the presentation of an *international animal health certificate* attesting that the donor birds:

- 1) showed no clinical sign of ND on the day of collection of the semen;
- 2) had not been vaccinated using ND live virus vaccine at any time before collection;
- 3) were kept in an *establishment* in the *exporting country* which was regularly inspected by the *Veterinary Authority*;
- 4) were kept in an *establishment* free from ND and not situated in an ND infected zone.

Article 2.1.15.14.

When importing from ND free countries, *Veterinary Administrations* should require:

for fresh meat of poultry

the presentation of an *international sanitary certificate* attesting that the entire consignment of meat comes from birds:

- 1) which have been kept in an ND free country since they were hatched or for at least the past 21 days;

- 2) which have been slaughtered in an *approved abattoir* and have been subjected to ante-mortem and post-mortem inspections for ND with favourable results.

Article 2.1.15.15.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for fresh meat of poultry

the presentation of an *international sanitary certificate* attesting that the entire consignment of meat comes from birds:

- 1) which have been kept in an *establishment* free from ND and not situated in an ND infected zone;
- 2) which have been slaughtered in an *approved abattoir* not situated in an ND infected zone and have been subjected to ante-mortem and post-mortem inspections for ND with favourable results.

Article 2.1.15.16.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for meat products of birds

the presentation of an *international sanitary certificate* attesting that:

- 1) the entire consignment of *meat products* comes from birds which have been slaughtered in an *approved abattoir* and have been subjected to ante-mortem and post-mortem inspections for ND with favourable results;
- 2) the *meat products* have been processed to ensure the destruction of the ND virus;
- 3) the necessary precautions were taken after processing to avoid contact of the meat with any source of ND virus.

Article 2.1.15.17.

When importing from ND free countries, *Veterinary Administrations* should require:

for products of animal origin (from birds) intended for use in animal feeding or for agricultural or industrial use

the presentation of an *international sanitary certificate* attesting that these products come from birds which have been kept in an ND free country since they were hatched or for at least the past 21 days.

## Article 2.1.15.18.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for meal and flour from meat and feather (from birds)

the presentation of an *international sanitary certificate* attesting that these products have been processed using heat treatment to ensure the destruction of the ND virus.

## Article 2.1.15.19.

When importing from countries considered infected with ND, *Veterinary Administrations* should require:

for feathers and down (from birds)

the presentation of an *international sanitary certificate* attesting that these products have been processed to ensure the destruction of the ND virus.

## APPENDIX 4 Procedures for surveillance and proof of freedom

Intensive surveillance aims to identify potential new cases. Because of the risk of spread of virus by inspectors, the following procedures should be adopted to minimise multiple farm inspections:

- industry reporting on flocks by telephone or facsimile;
- telephone survey;
- serological testing;
- dead bird pick up (DBPU) and transport to a laboratory; and
- visits to potential new cases only identified by the above.

There are three phases:

- early in an outbreak;
- later in an outbreak when recovered flocks have seroconverted;
- if the disease is established.

### Training needs

Surveillance officers must:

- be familiar with the poultry industry; or
- pass information to poultry industry experts for interpretation.

Surveillance officers must have access to:

- flock health records expected for the class of stock under normal circumstances;
- 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 exotic ND virus.

### Information required

Information will be required from high risk flocks in the RA and CA. These could be:

#### Poultry:

breeders  
started pullets  
layers  
meat chickens  
turkeys  
game birds  
backyard flocks  
fancy flocks

#### Other:

pigeons  
aviaries  
pet shops

A reporting procedure which includes the following observations should be adopted:

*Perusal of records and interviews of owner/staff for the following:*

- any decline in feed or water consumption;
- any decline in egg production from normal to complete cessation;
- any increase in mortality; and
- any decline in hatchability.

*Examination of flocks for the following:*

- any respiratory disease;
- any flock depression;
- any nervous signs; and
- any wet dropping problems.

*Field autopsy findings which include any of the following:*

- cyanosis of the comb;
- haemorrhages and necrosis in the proventriculus, gizzard and small intestinal walls;
- petechial haemorrhage on other organs and in the trachea;
- catarrhal or congestive tracheitis;
- laryngitis; and
- thickened cloudy airsacs.

Decisions should be made at the LDCC on which laboratory will be responsible for the laboratory testing and who will manage, and evaluate the results for, the following situations:

- before a diagnosis is confirmed;
- after a diagnosis is confirmed (CVO to decide whether diagnosis is to be on clinical signs or laboratory investigation); and
- after repopulation of IPs and DCPs (see Section 2.2.12).

### **Procedures during the outbreak**

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

- twice weekly (or more frequently if needed) telephone/facsimile reporting by producers and DBPU with field visit, if needed;
- twice weekly (or more frequently if needed) telephone surveillance of SPs and DBPU and field visit, if needed;
- serological sampling of flocks to provide a 95% level of confidence the virulent Newcastle disease virus is not present at the 5% level. Titres of  $>2^{10}$ ; or if  $>25\%$  of the sample is  $>2^5$  should be viewed with suspicion.
- suspicious flocks should be quarantined, virus isolation attempted and the flock resampled in 7 days time.

*In the CA.* Surveillance in the CA will commence immediately the outbreak has been confidently contained and will involve:

- weekly telephone surveillance of susceptible flocks including other species;
- serological sampling;
- weekly reporting on flock health by producers;
- follow-up on any unusual disease conditions;
- serological sampling of meat chickens and spent hens at abattoirs;
- serological sampling of a representative sample of commercial poultry flocks to provide a 95% level of confidence the virulent Newcastle disease virus is not present at the 5% level in the flock. Titres of  $>2^{10}$ , or if  $>25\%$  of the sample is  $>2^5$  should be viewed with suspicion; and

- suspicious flocks should be quarantined, virus isolation attempted and the flock resampled in 7 days time.

**Wider geographical surveys**

Wider geographical surveys may be required within the free area and these should commence immediately the outbreak has been confidently controlled. Surveys should aim at a 95% confidence level of detecting a 5% infection rate in at least 1% of the commercial flocks.

**Procedures to establish proof of freedom**

Proof of freedom from ND can best be achieved by clinical observations and dead-bird sampling of repopulated sheds and possible disease outbreaks, rather than widespread serological testing.

Some serological surveillance will be required and it is recommended that this should be performed on former IPs, DCPs and SPs, at 30 days after repopulation and at 5 months to establish a 95% confidence of detecting infection at less than 5%. This is to be supported by twice-weekly clinical examinations for 30 days then fortnightly for 5 months, and virus isolation carried out on dead birds. Seropositive flocks will require further investigation and virus isolation.

Further testing may be considered in other areas if the epidemiological information suggests this is warranted.

## APPENDIX 5 Cooking temperatures and times for various poultry products

Product	Temperature (applied T°C)	Temperature (inside of product)	Duration
<b>Crumbed line</b>			
<b>1. Nuggets</b>			
(a) Fully cooked	210°C	75°C	1 min (average)
(b) Partially cooked <sup>1</sup>	196–207°C	–1°C <sup>2</sup>	27 sec
(c) Further cooking of (b) at fast-food outlets	182°C	85°C	10–15 min
<b>2. Roast chicken</b>			
Chicken loaf	215°C	85–90°C	60 min
<b>3. Eggs</b>			
Liquid whole	–	65°C	4.5 min
Liquid yolk	–	64.5–65°C	5 min
Liquid white	–	55.5°C	10 min
Pavlova line	150°C	80°C	45–55 min
Dry whole/yolk	187°C	71°C	–

Source: Arzey (1989)

<sup>1</sup> Flash fried (eg nuggets)

<sup>2</sup> –1°C is the temperature at which product is held, then subject to a short period of high temperature, so it is unlikely that the core temperature reaches a high enough temperature for long enough to kill virus.

## **APPENDIX 6    Extract from a submission to the Animal Health Committee Meeting No. 36, October 1985, by the Australian Poultry Industries Association**

### **PRE-AGREEMENT**

#### **Discussion**

#### **Guidelines for the treatment and distribution of cooked poultry products in the event of an outbreak of exotic diseases**

##### **Preamble**

1. The objective of quarantine of a given premises or geographic area within which an exotic disease has been suspected or diagnosed is to reduce the risk of spread of that disease.
2. There is considerable, and increasing, interstate trade in cooked poultry products with a strong trend towards the establishment of large, highly specialised, capital intensive plants supplying a limited range of cooked products throughout Australia. It is anticipated that this trend will accelerate in the future. Total bans on the movement of all poultry and poultry products such as occurred in the recent Victorian AI outbreak could have a devastating effect on such plants.
3. In the category of cooked products as defined above are included primary poultry products such as roast and smoked poultry; further processed products such as poultry nuggets, poultry rolls; secondary products such as poultry stock cubes, soup mixes, and other products such as canned and dried pet foods, which often rely heavily on poultry ingredients.
4. Provided that certain guidelines on the treatment of such products are followed they will not represent a quarantine risk.

##### **Guidelines**

1. The poultry used to prepare such products may not be derived from infected premises or dangerous contact premises.
2. The cooked poultry plant must observe a high degree of quarantine to ensure no contact with infected premises.
3. The cooking process must ensure that a temperature sufficient to kill the exotic disease virus is achieved at all points within the cooked product. In the case of avian influenza a temperature of 71°C must be achieved. In the case of Newcastle disease, a temperature of 80°C must be achieved.
4. Before authorisation is given to distribute cooked product, the plant and process must be inspected by an authorised inspector of the State Department of Agriculture. Plant management must furnish the inspector with whatever proofs of the constancy and reliability of the process that he may require.
5. Cooked product must be despatched in clean sealed vehicles. Raw poultry products must not be distributed in the same vehicle.

## GLOSSARY

ANEMIS	Animal Health Emergency Information System. A system for the collection, assimilation, actioning and dissemination of essential disease control information using paper documentation and a computer database.
Animal by-products	Products of animal origin destined for industrial use, eg raw hides and skins, fur, wool, hair, feathers, hooves, bones, fertiliser.
Animal products	Meat products and products of animal origin (eg eggs, milk) for human consumption or for use in animal feeding.
AUSVETPLAN	A series of documents that outline the Australian approach to the eradication/control of the more important animal diseases not presently occurring in this country; linking policy, strategies, implementation, coordination and emergency-management plans.
Chief veterinary officer	The veterinary officer of each State or Territory animal health authority who has responsibility for animal disease control in that State or Territory.
Consultative Committee on Exotic Animal Diseases	A committee of State/Territory CVOs, AAHL and CSIRO, chaired by the CVO of Australia (Cwlth AFFA), to consult in emergencies due to the introduction of an exotic disease of livestock, or serious epizootics of Australian origin.
Control area	A declared area in which defined conditions apply to the movement into, out of, and within, of specified animals or things. Conditions applying in a control area are of lesser intensity than those in a restricted area. The limits of a control area and the conditions applying therein may be varied rapidly according to need ( <i>see</i> Appendix 1).
Critical date	The critical date is the earliest time ND virus entered the premises. The critical date is determined by the CVO in consultation with the laboratory 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 bird	An bird showing no clinical signs of disease but which, by reason of its probable exposure to disease, will be subjected to disease control measures.
Dangerous contact premises	Premises containing a dangerous contact animal(s) ( <i>see</i> Appendix 1).
Declared area	A defined tract of land for the time being subject to disease control restrictions under exotic disease legislation. Types of declared areas include <i>restricted area</i> ; <i>control area</i> ; <i>infected premises</i> ; and <i>dangerous contact premises</i> .
Depopulation	The humane slaughter and disposal of flocks on IPs and exposed flocks on DCPs.

Disinfectant	An agent used to destroy microorganisms outside a living animal.
Disposal	Sanitary removal of animal carcasses and things by burial, burning or some other process so as to prevent the spread of disease.
Egg marketing premises	A 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.
Exotic animal disease	Disease affecting animals (which may include man) and which does not presently occur in Australia.
Exotic Newcastle disease virus	Virulent strains of ND virus that do not occur in Australia.
Fomites	Inanimate objects (eg boots, clothing, equipment, vehicles, crates, packagings) that can carry the exotic agent and 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 partially cooking for fast food outlets and retail markets.
Haemagglutination	Agglutination of red blood cells by a specific antibody or other substance.
Incubation period	The period which elapses between the introduction of the pathogen into the animal and the occurrence of the first clinical signs of the disease.
Infected premises	<i>see</i> Appendix 1
Integrator	An individual or party who owns poultry on two or more places and usually owns feed mills and processing plants.
Lentogenic	Form of ND virus producing mild or subclinical disease with predominantly respiratory signs.
Local disease control centre	An emergency operations centre responsible for the command and control of field operations in a defined area.
Mesogenic	Form of ND virus producing low mortality and respiratory disease.
Movement control	Restrictions placed on movement of animals, people and things to prevent the spread of disease.
Neurotropic	Producing nervous and usually respiratory signs.
Petechial haemorrhage	Tiny, flat, red or purple spots in the skin or mucous membrane caused by bleeding from small blood vessels.
Peyer's patches	Lymphoid organs in the small intestines.

Polymerase chain reaction	A method of amplifying and analysing DNA sequences that can be used to detect the presence of virus DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel
Processing plant	An abattoir for slaughtering poultry for human consumption, with chilled and frozen storage facilities.
Proventriculus	Front (thin-walled) part of stomach in birds.
Psittaciformes (adj: psittacine)	Parrots and related groups of birds.
Quarantine	Legal restrictions imposed on a place, animal, vehicle or other things limiting movement.
Restricted area	A declared area in which defined rigorous conditions apply to the movement into, out of, and within, of specified animals, persons or things ( <i>see</i> Appendix 1).
Risk enterprise	A livestock or livestock-related enterprise with a high potential for disease spread, eg. an abattoir, hatchery or livestock market.
Salvage	Recovery of some (but not full) market value by treatment and use of products, according to disease circumstances.
Sentinel animals	Animals of known health status monitored for the purpose of detecting the presence of a specific exotic disease agent.
Septicaemia	Infection of blood stream with bacteria.
Seroconversion	Appearance in the blood serum of antibodies following vaccination or natural exposure to a disease agent.
Serotype	A subgroup of a genus of microorganisms identifiable by the antigens carried by the members.
Stamping out	Eradication procedures based on quarantine and slaughter of all infected animals and animals exposed to infection.
State/Territory disease control headquarters	The emergency operations centre that directs the disease control operations to be undertaken in the State/Territory.
Surveillance	A systematic program of inspection and examination of animals or things to determine the presence or absence of an exotic disease.
Susceptible species	Animals that can be infected with the disease (for ND — all avian species).
Suspect bird	An bird that may have been exposed to an exotic disease such that its quarantine and intensive surveillance is warranted; OR 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 things suspected of being contaminated by an exotic disease agent.
Suspect premises	Premises containing suspect animals ( <i>see</i> Appendix 1).

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Tracing	The process of locating animals, persons or things that may be implicated in the spread of disease, so that appropriate action can be taken.
Vaccine	
–attenuated (‘live’)	A vaccine prepared from infective or ‘live’ microbes that have lost their virulence but have retained their ability to induce protective immunity.
–inactivated	A vaccine prepared from a virus that has been inactivated (‘killed’) by chemical or physical treatment.
Velogenic	Form of ND virus producing high mortality.
– neurotropic	Form of ND causing high mortality with predominantly nervous and respiratory signs.
– viscerotropic	VVND — form of ND causing high mortality with pathological changes in visceral organs, mainly haemorrhagic enteritis.
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.
viscerotropic	attracted to the visceral organs, especially those confined to the abdomen
Viraemia	The presence of viruses in the blood.
Zoning	The process of defining disease-free and infected zones in accord with OIE guidelines, in order to facilitate trade.

## Abbreviations

AAHL	CSIRO Australian Animal Health Laboratory, Geelong
AI	Avian influenza
ANEMIS	Animal health emergency information system
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand CA Control area
CAB	Cage and aviary birds
CAM	Chorioallantoic membrane
CCEAD	Consultative Committee for Exotic Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	Chief veterinary officer
DBPU	Dead bird pick up
DCP	Dangerous contact premises
ELISA	Enzyme-linked immunosorbent assay
HI	Haemagglutination inhibition
IP	Infected premises
ND	Newcastle disease
OIE	World Organisation for Animal Health [Office International des Epizooties]
PMV	Paramyxovirus
RA	Restricted area
SP	Suspect premises
VVND	Viscerotropic velogenic Newcastle disease

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