AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Disease Strategy

Foot-and-mouth disease

Version 3.4, 2014

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

Agriculture Ministers' Forum

This disease strategy forms part of:

AUSVETPLAN Edition 3

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

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DISEASE WATCH HOTLINE

1800 675 888

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

Preface

This disease strategy for the management of foot-and-mouth disease (FMD) in Australia is an integral part of the **Australian Veterinary Emergency Plan**, or **AUSVETPLAN (Edition 3)**. AUSVETPLAN structures and functions are described in the AUSVETPLAN **Overview Document**. The disease strategy provides information about the disease (Section 1); the relevant risk factors and their treatment, and the options for management of a disease outbreak, depending on the circumstances (Section 2); the suggested starting policy and guidelines for agencies and organisations involved in a response to an outbreak (Section 3); and declared areas and premises, and quarantine and movement controls (Section 4).

This manual has been produced in accordance with the procedures described in the AUSVETPLAN **Overview Document** and in consultation with Australian national, state and territory governments, and the ruminant and pig industries.

FMD is included on the World Organisation for Animal Health (OIE) list of notifiable diseases as a multiple species disease. OIE-listed diseases are diseases with the potential for international spread, significant mortality or morbidity within the susceptible species, and/or potential for zoonotic spread to humans.[1] OIE member countries that have been free from a notifiable disease are obliged to notify the OIE within 24 hours of confirming the presence of the disease.

The strategies in this document for the diagnosis and management of an outbreak of FMD are based on the recommendations in the OIE *Terrestrial Animal Health Code*[2] and the OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*.[3] The strategies and policy guidelines are for emergency situations, and are not applicable to quarantine policies for imported livestock or livestock products.

In Australia, FMD is included as a Category 2 emergency animal disease under the *Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses* (EAD Response Agreement).[4]

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

Guidelines for the field implementation of AUSVETPLAN are contained in the disease strategies, operational procedures manuals and management manuals. Industry-specific information is given in the relevant enterprise manuals. The full list of AUSVETPLAN

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1 These criteria are described in more detail in Chapter 1.2 of the OIE *Terrestrial Animal Health Code* (www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.1.2.htm).

2 www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm

3 www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.01.05_FMD.pdf

4 Information about the EAD Response Agreement can be found at www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ead-response-agreement

manuals that may need to be accessed in an emergency is shown below. The complete series of manuals is available on the Animal Health Australia website.[5]

AUSVETPLAN manuals

Disease strategies

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

Operational manuals

- Decontamination
- Destruction of animals
- Disposal
- Livestock welfare and management
- Valuation and compensation
- Wild animal response

Enterprise manuals

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

Management manuals

- Control centres management (Parts 1 and 2)
- Laboratory preparedness

Overview document

Nationally agreed standard operating procedures[6]

Nationally agreed standard operating procedures have been developed for use by jurisdictions during responses to emergency animal disease incidents and emergencies. These procedures underpin elements of AUSVETPLAN and describe in detail specific actions undertaken during a response to an incident.

5 www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ausvetplan/
6 www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/nasops/

Contents

Tables

1 Nature of the disease

Foot-and-mouth disease (FMD) is an acute, highly contagious viral disease of domestic and wild cloven-hoofed animals (ungulates). The disease is clinically characterised by the formation of vesicles (fluid-filled blisters) and erosions in the mouth and nostrils, on the teats, and on the skin between and above the hoofs. FMD can cause serious production losses and is a major constraint to international trade in livestock and livestock products.

1.1 Aetiology and pathogenicity

FMD is caused by a member of the *Picornaviridae* family of RNA viruses. There are seven immunologically and serologically distinct serotypes of FMD virus (FMDV): types O, A, C, SAT 1, SAT 2, SAT 3 and Asia 1. Within each serotype, there is a wide spectrum of antigenic diversity. Strains within each serotype may differ in their infectivity for different species.

1.2 Susceptible species

1.2.1 Ungulates

Ungulates are the natural domestic and wild hosts of FMDV. They include cattle, pigs, sheep, goats, camelids (camels, llamas and alpacas), bison, water buffalo (*Bubalus bubalis*), African buffalo (*Syncerus caffer*), deer, antelopes, gazelles, moose, impala, giraffe, wildebeest, eland and warthog. In addition, elephants are known to be susceptible.

Australia has large populations of domestic and feral animals that are fully susceptible to infection with FMDV, and capable of transmitting the disease. These populations include intensively managed animals in dairies and piggeries; animals in more extensive cattle, sheep and deer enterprises; animals in zoos; and feral pigs, cattle, goats and buffalo.

1.2.2 Australian native animals and rabbits

Several Australian marsupial species (red kangaroo, grey kangaroo, tree kangaroo, wombat, brushtail possum, long-nosed bandicoot, potoroo, water rat, brown marsupial mouse, Bennett's wallaby), as well as echidnas and feral European rabbits, have been tested overseas for susceptibility to FMD (Snowdon 1968). These species showed minimal disease or spread of infection between animals following experimental inoculation with FMDV. The author of the study concluded that the Australian fauna tested would participate in the spread of FMD in the field only under exceptional conditions. Close contact would be required between livestock and fauna for spread of infection — for example, at watering holes in droughts.

1.2.3 Other animals

FMDV may be transmitted to mice, rats, guinea pigs, hamsters, chickens and various species that exist in the wild in other countries — including European hedgehogs, chinchillas, muskrats, armadillos and peccaries. These species are not generally implicated in the spread of FMD.

Tapirs may be susceptible to FMD, with the disease reported in South American and Malayan tapirs during an outbreak at a zoo (Ramsay and Zainuddin 1993) and possible links to deaths in tapirs in Peru (Hernandez-Divers et al 2007). Other perissodactyls (which include horses and rhinoceros) are not susceptible. A comprehensive review of FMD in wildlife was published by Thomson et al (2003). Evidence to date suggests that wild and feral populations of animals (apart from African buffalo) pose a low risk of transmitting infection to domestic livestock.

1.2.4 Humans

People can be infected with FMDV through wounds to the skin by handling diseased animals or the virus in the laboratory, or through the mouth lining by drinking infected milk, but infection of people is rare. Infection cannot occur by eating meat from infected animals.

The infection is temporary and mild, only very occasionally resulting in clinical disease (fever, vesicles on the hands or feet or in the mouth). FMD is not considered a public health problem (Armstrong et al 1967, Bauer 1997).

Hand, foot and mouth disease of humans (most often caused by an unrelated virus, coxsackievirus type A16) is present in Australia and may be confused clinically with FMD.

1.3 World distribution and occurrence in Australia

FMD is endemic throughout the Middle East, Africa, Asia and most of South America. The World Organisation for Animal Health (OIE) maintains a list of countries and zones that it recognises to be officially FMD free (with and without vaccination).[7]

Among Australia's closest neighbours, Indonesia, Singapore, Papua New Guinea, New Zealand, the Philippines and the Pacific island nations are free from FMD. Parts of Malaysia are also free. The OIE's World Animal Health Information Database provides information on the FMD situation of member countries.[8] This is largely based on self-reporting.

In Australia, minor outbreaks of possible FMD occurred in 1801, 1804, 1871 and 1872. The last incident occurred in Victoria following importation of a bull from England. Two farms were involved before the disease was eradicated. FMD has not been diagnosed in Australia since.

1.4 Diagnostic criteria

1.4.1 Clinical signs

The classical signs and lesions of FMD are described below. However, a wide range of clinical syndromes can occur, ranging from inapparent disease with minimal lesions to severe clinical disease.

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7 www.oie.int/animal-health-in-the-world/fmd-portal/country-freedom
8 www.oie.int/wahid-prod/public.php?page=disease_outbreak_map

Cattle

In cattle, the earliest clinical signs are dullness, poor appetite and a rise in temperature to 40–41 °C. In dairy cows, milk yield drops considerably. Salivation and lameness may be observed, depending on the stage of infection. Affected animals move away from the herd and may be unwilling or unable to stand.

Vesicles may appear inside the mouth, on the tongue, cheeks, gums, lips and/or palate. At first, they are small, blanched areas. Fluid accumulates under these areas to form vesicles, which develop quickly and might reach 30 mm or more in diameter, especially on the dorsum of the tongue. Two or more blisters can join to form a larger one, sometimes covering as much as half of the surface of the tongue. However, intact vesicles are not often seen, because they usually burst easily and within 24 hours, leaving a raw surface fringed by blanched flaps of epithelium. Alternatively, the fluid may drain, leaving an intact area of blanched epithelium. There may be profuse, frothy saliva around the mouth and, at intervals, a smacking or sucking sound. The lesions heal rapidly over several days.

Vesicles may form between the claws of the feet and along the coronary band. Initially, they appear as areas of blanched epithelium, and the underlying blisters may not be obvious unless the epithelium is torn away. Foot lesions may also be masked by dirt, and careful examination of feet is needed in muddy conditions. There might be signs of pain in the feet; when forced to rise, the animal might walk gingerly and occasionally shake a leg as if to dislodge an object wedged between the claws. As the lesions heal, dry separation of the heels along the coronary band can occur. From 2 to 6 weeks after infection, the feet appear to be 'slippered' as the horn of the heel separates and may be easily removed from the underlying corium. Cracks in the heels can take a long time to heal in some animals, causing chronic lameness and weight loss.

Lesions can also occur on the teats and udder, and reduced lactation, mastitis and abortion are common.

Mortality in adults is usually low to negligible, but up to 50% of calves might die due to cardiac involvement (see below) and complications such as secondary infection, exposure or malnutrition.

The disease can also be mild or inapparent, especially in *Bos indicus* breeds.

Pigs

In pigs, the main sign is lameness, although this can be masked if the affected animals are on soft ground. Blisters form around the top of the foot, on the heels and between the claws. The epithelium may appear blanched or raw and ragged at the coronary band at the top of the hoofs. Affected pigs prefer to lie down and, when made to move, hobble painfully and squeal loudly. The feet might become 'thimbled' as the horny layer separates and is easily removed from the underlying corium. After several days, granulation tissue and new horn growth will be evident.

Snout lesions may develop, but quickly rupture, and mouth lesions are difficult to see. Blisters can develop on the teats and spread over the skin of the mammary glands. Abortion is common and might even be the presenting clinical problem. Significant mortality can occur in piglets.

Sheep and goats

Although the disease is usually mild in sheep and goats, with few lesions, severely affected animals can succumb to sudden, severe lameness affecting one or more feet. Blisters form around the top of the foot and between the claws. They are not often noticeable in the mouth, but may develop on the tongue and dental pad. Affected sheep look sick and are reluctant to stand. Milk yields can be expected to fall in commercial dairy goats and sheep (Kitching and Hughes 2002). Significant mortality can occur in lambs.

During the 2001 epidemic in the United Kingdom (UK), signs in sheep were sometimes so mild that the presence of the disease was revealed only by very close examination of all the sheep in a flock.

Ageing of lesions

The descriptions in Table 1.1 for estimating the age of FMD lesions in cattle and pigs are based on those of Kitching and Mackay (1995) and are illustrated in the publication *Foot and Mouth Disease Ageing of Lesions* (DEFRA 2005).

Table 1.1 Estimating the age of lesions of foot-and-mouth disease

Day of clinical disease	Appearance of lesion
Day 1	Blanching of epithelium, followed by formation of fluid-filled vesicles
Day 2	Freshly ruptured vesicles, characterised by raw epithelium, a clear edge to the lesion and no deposition of fibrin
Day 3	Lesions start to lose their sharp demarcation and bright red colour; deposition of fibrin starts to occur
Day 4	Considerable fibrin deposition has occurred, and regrowth of epithelium is evident at the periphery of the lesion
Day 7	Extensive scar tissue formation and healing have occurred; some fibrin deposition is usually still present

For other illustrations of lesions, see Geering et al (1995).

The time of introduction of infection to a pig herd can be estimated as follows:

- Allow time for the incubation period (see Section 1.6.1).
- Allow 7 days for the lesions to mature and new horn growth to begin.
- Examining all eight cleaned claws on each of several pigs for lesions, measure the distance from the coronary band to the lesion. Allow 2 mm per week in weaners and 1 mm per week in adult pigs.

Lesions in sheep are too transient to be used for gauging the time of infection.

1.4.2 Pathology

The most common route of infection, especially for ruminant species, is by inhalation of virus in droplets or aerosol. The virus primarily replicates in epithelial cells in the pharynx and dorsal soft palate and then spreads via the blood to secondary sites, such as the mammary gland. It can also persist on animal skin cells, which could be an important source of infectious FMD aerosol (Dillon 2011). Once a herd is infected and animals are exposed to larger amounts of virus, infection can occur via other routes, particularly through minor abrasions to the integument of the feet, mouth, muzzle, nose and udder. Higher doses of

virus are required for oral infection, and ruminants are much more resistant to oral infection than pigs. Oral infection is an important pathway of infection for pigs (see Section 1.6).

Replication in epithelial tissues occurs in the stratum spinosum. It results in the accumulation of intracellular and extracellular fluid, leading to the development of a vesicle. Sometimes, early rupture of this layer results in escape of fluid and a desiccated lesion. Other important secondary sites of replication include the ruminal lymph nodes and heart. In young animals, sudden death from myocardial necrosis might occur before the vesicles develop. Apart from identifying vesicles and heart lesions, pathological examination is important only in the differential diagnosis of other diseases.

1.4.3 Laboratory tests

Specimens required

Specimens essential for the rapid confirmation of FMD include (also refer to Table 1.2):

- *for agent detection and characterisation* — fresh samples
  - from live animals, vesicular fluid, epithelial coverings, flaps or swabs of vesicular lesions, and whole blood; oesophageal–pharyngeal fluid (via probangs) can also be used
  - from dead animals (in addition to samples from live animals, if available), tissue samples including lymph nodes (especially those around the head), thyroid, adrenals, kidney, spleen and heart, and any other observed lesions
- *for serology* — serum
- *for histopathology* (for differential diagnosis) — samples in formalin of lesion tissue (as above), including lesions of the upper gastrointestinal tract.

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

Transport of specimens

Specimens should initially be sent to the state or territory diagnostic laboratory. They will then be forwarded to the CSIRO Australian Animal Health Laboratory (CSIRO-AAHL), Geelong, for emergency disease testing, after the necessary clearance has been obtained from the chief veterinary officer (CVO) of the state or territory of the suspect case, and after the CVOs of Victoria and Australia have been informed about the case and the transport of the specimens to Geelong.

Unpreserved tissue and blood specimens should be sent with water ice or frozen gel packs (dry ice or liquid nitrogen if a delay of more than 48 hours is expected) in a specimen-transport container approved by the International Air Transport Association. Unless oesophageal–pharyngeal fluid samples will arrive at the laboratory on the same day, they should be frozen, preferably in liquid nitrogen, very soon after sampling and packed with dry ice for transport. For further information, see the **Laboratory Preparedness Manual**.

Laboratory diagnosis

The laboratory tests currently available at CSIRO-AAHL are shown in Figure 1.1 and Table 1.2. They include direct tests such as enzyme-linked immunosorbent assays (ELISAs) that can detect FMDV antigens in vesicular fluid or homogenates of epithelial tissue from

lesions. These tests are used initially with new samples to provide serotype-specific results; they provide results within 3–4 hours and provide the earliest possible laboratory confirmation of FMDV. A negative result does not confirm the absence of FMDV; isolation in tissue culture is required to rule out FMD.

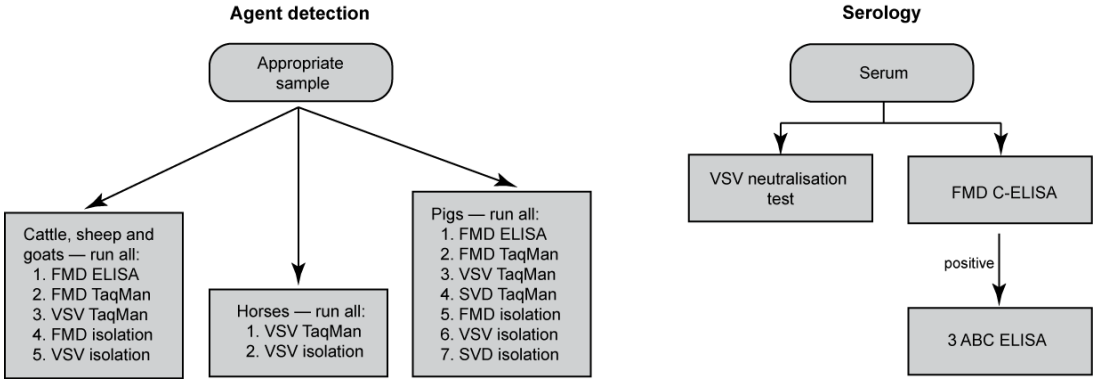
CSIRO-AAHL can also perform real-time polymerase chain reaction (PCR) using TaqMan probes as a rapid and reliable diagnostic test. The samples are the same as for the antigen-detection ELISA. TaqMan-based real-time PCR also takes 4 hours. However, this test is not serotype specific and can only confirm the presence of FMDV nucleic acid.

Virus isolation in cell culture is useful for specimens with small amounts of virus, to amplify the virus for subsequent characterisation and strain differentiation. This procedure takes 24–48 hours, or longer if passaging is required. In samples with larger amounts of virus, characterisation may be possible without the need to amplify the virus in cell culture.

Antibodies to the whole virus or nonstructural antigens appear in the serum 7–10 days after infection or vaccination. Several ELISA-based tests can be used to detect these antibodies. These tests are used to differentiate between infection-induced and vaccine-induced antibodies (DIVA tests; see Table 1.2).

Additional diagnostic tests include sequencing and electron microscopy. Nucleotide sequencing of selected genes or whole genomes can be used in molecular epidemiology.

Animal infection or transmission is rarely used for diagnosis, having been replaced by the more efficient and sensitive in vitro procedures described above.



3ABC-ELISA = DIVA test (see Table 1.2); C-ELISA = competition ELISA; ELISA = enzyme-linked immunosorbent assay; FMD = foot-and-mouth disease; SVD = swine vesicular disease; VSV = vesicular stomatitis virus
Note: The CSIRO Australian Animal Health Laboratory treats any vesicular disease exclusion by testing for all appropriate vesicular disease: samples submitted for either FMD, VSV or SVD exclusion will be automatically tested for the other relevant vesicular diseases.

Figure 1.1 CSIRO-AAHL vesicular disease testing algorithm

Table 1.2 Laboratory tests currently available at CSIRO-AAHL for the diagnosis of foot-and-mouth disease

Test	Specimen required	Test detects	Time taken to obtain result
Agent detection			
qPCR	Vesicular fluids, swabs or epithelial tissue	Viral RNA	4 hours
ELISA	Vesicular fluids, swabs or epithelial tissue	Antigen and serotype identification	3–4 hours
Electron microscopy	Tissues from lesions	Virus	3–4 hours
Agent characterisation			
Virus isolation and identification	Tissues	Virus	1–4 days
RT-PCR and sequencing	Tissue or virus isolate	Viral RNA	2–3 days
Serology			
Liquid-phase blocking ELISA	Serum	Specific antibody	1 day
Solid-phase competition ELISA (C-ELISA)	Serum	Specific antibody	1 day
3ABC-ELISA (DIVA test)	Serum	Specific antibody	1 day

DIVA = differentiating infected from vaccinated animals; ELISA = enzyme-linked immunosorbent assay; PCR = polymerase chain reaction; qPCR = quantitative real-time polymerase chain reaction; RNA = ribonucleic acid; RT-PCR = reverse transcriptase PCR
Source: Information provided by CSIRO-AAHL, 2010 (refer to CSIRO-AAHL for most up-to-date information).

Timelines for characterisation of the outbreak strain

Following a positive or equivocal diagnosis of FMD, conventional PCR and sequencing of the VP1 gene will be used to characterise the virus. These results will confirm the serotype of the virus and allow differentiation of strains to assist vaccine selection and epidemiological investigations. Under ideal circumstances, the results are expected to be available within 54 hours of arrival of the specimens at CSIRO-AAHL.

1.4.4 Differential diagnosis

The following diseases and conditions should be considered in a differential diagnosis of FMD:

- swine vesicular disease
- vesicular stomatitis
- vesicular exanthema
- rinderpest[9]
- bluetongue

[9] OIE Resolution 18/2011 recognises that all 198 countries with rinderpest-susceptible animal populations are free from the disease.

- peste des petits ruminants
- mucosal disease
- bovine papular stomatitis
- bovine ulcerative mammalitis
- pseudocowpox
- bovine malignant catarrh
- contagious ecthyma ('scabby mouth')
- infectious bovine rhinotracheitis/infectious pustular vulvovaginitis
- scalding, wetting, contact dermatitis, photosensitisation
- contact with certain plants containing furocoumarins (especially Umbelliferae — parsnips, celery, parsley), resulting in photosensitisation (Montgomery et al 1987ab, Pathak et al 1962)
- mouth lesions in pigs from hot feed
- laminitis, hoof abscess, footrot (eg from bad floors, new concrete, mud).

Case definition

FMD should be considered in the differential diagnosis of a case whenever vesicles are seen in cloven-hoofed animals, including camelids. A provisional diagnosis of FMD should then be made when there is a combination of two or more of the following clinical signs:

- acute lameness in a group of animals
- excess salivation
- vesicles in the mouth, on the feet and/or on the teats
- fever
- a considerable drop in milk yield (in dairy species).

In sheep, clinical signs are usually milder and more subtle than in other species, such as pigs and cattle. For sheep, close veterinary physical inspection of mouths and hoofs is often required to identify vesicles.

The OIE case definition for FMD is an animal infected with FMDV; this can be in either the presence or the absence of clinical signs. The OIE defines the occurrence of FMDV infection as:

- FMDV has been isolated and identified as such from an animal or a product derived from that animal; or
- viral antigen or viral RNA specific to one or more of the serotypes of FMDV has been identified in samples from one or more animals, whether showing clinical signs consistent with FMD or not, or epidemiologically linked to a confirmed or suspected outbreak of FMD, or giving cause for suspicion of previous association or contact with FMDV; or
- antibodies to structural or nonstructural proteins of FMDV that are not a consequence of vaccination have been identified in one or more animals showing clinical signs consistent with FMD, or epidemiologically linked to a confirmed or suspected outbreak of FMD, or giving cause for suspicion of previous association or contact with FMDV.

A definitive diagnosis would be based on confirmed laboratory identification of FMDV at CSIRO-AAHL, by virus isolation or other methods (see Table 1.2). In the absence of clinical signs, serological positives would require investigation to clarify the situation.

1.4.5 Treatment of infected animals

No specific treatment is available for FMDV-infected animals.

1.5 Resistance and immunity

1.5.1 Innate and passive immunity

In endemic countries, zebu breeds (*Bos indicus*) usually show milder clinical signs than introduced European breeds (*Bos taurus*). However, they can still become infected and transmit infection. Camelids appear to have a high natural resistance to infection.

Susceptibility to infection can change with the animal's age. Clinical signs in younger naive stock tend to be more severe, unless the animal is protected by maternal antibodies.

1.5.2 Active immunity

The immunity conferred by natural infection and vaccination is largely strain specific. There is variable cross-protection between strains of FMDV within the same serotype, and very little to none between different serotypes. Animals can be infected by multiple serotypes.

Following infection with FMDV, it is possible for ruminants, but not pigs, to become carriers,[10] in which virus persists in the pharynx in the presence of circulating antibody (see Section 1.6.2). Despite a number of anecdotal reports, as yet, there is no evidence from the field that carriers (other than African buffalo) have been responsible for initiating new infections in susceptible animals.

1.5.3 Vaccination

Vaccination has been successfully used in many parts of the world to control FMD. The current inactivated vaccines are either aqueous based (with an aluminium hydroxide adjuvant) or single- or double-oil emulsion based. Most of the viral nonstructural proteins are removed in a purification process, and adjuvant is added. An uninfected vaccinated animal therefore produces antibodies predominantly to the structural proteins of the virus, and this can be used to differentiate between naturally infected and uninfected vaccinated animals (IAEA 2007) — this is known as DIVA testing. Antibodies to the nonstructural proteins in uninfected animals are more likely to occur with repeated vaccination, but this depends on the purity of the vaccine used.

The immune responses of different species to emergency vaccination in the field have not been well reported. Experimentally, the immune response appears to be fairly consistent for cattle, sheep, goats and pigs, with protective immunity achieved within 7 days and often as early as 4 days after vaccination (Barnett and Carabin 2002).

[10] Carriers are defined as ruminants in which virus can be intermittently found in the oropharyngeal area more than 28 days after infection, often without the animals displaying clinical disease.

Vaccinated animals may become infected, but clinical signs are generally masked. Because they can still become infected, vaccinated animals must be subject to biosecurity and movement controls. The incidence of clinical signs is influenced by the interval between vaccination and infection (declining as this interval increases), the match between the outbreak strain and the vaccine strain, the response of the animal's immune system to vaccination, and the vaccine formulation used (Barnett and Carabin 2002). A well-matched vaccine can reduce the risk of infection and the quantity of virus excreted by animals if they do become infected.

Resistance to clinical disease induced by currently available high-potency vaccines wanes after 4–6 months, so vaccination must be repeated at 6-monthly intervals. If oil adjuvant vaccines are used 6-monthly for 2 years, annual revaccination might then be considered.[11]

For eradication purposes, vaccination can be used in different ways:

- If destruction and disposal of infected animals or suspects are likely to be delayed for more than 48 hours (Barnett and Carabin 2002), or there is a high risk of disease spread into surrounding concentrated populations, vaccine may be applied, if appropriate, within known infected areas ('suppressive' vaccination).
- Vaccination can be applied outside infected areas to protect animals from infection ('protective' vaccination) — for example, surrounding an infected area to create a barrier of immune animals between the infected and uninfected areas ('ring' vaccination), or to protect specific high-value or rare groups in uninfected areas ('targeted' vaccination).
- Mass ('blanket') vaccination can be applied to large numbers of animals if disease spread is significant.

If Australia is to use vaccine during an outbreak, there may be delays associated with the time to characterise the virus, source the vaccine from the Australian FMD Vaccine Bank (see Section 3.2.5), distribute the vaccine and vaccinate animals, and for the animals to develop an immune response.

During an outbreak, since vaccine efficacy is affected by the match between the vaccine and the field strain, active monitoring of FMDV mutations is necessary; the vaccine strains may need to be adjusted during the course of a prolonged outbreak.

Cattle and, to a lesser extent, sheep and goats, can become carriers after infection. Vaccinated animals that are exposed to infection within a few days of vaccination can become carriers. Field evidence suggests that the risk is low of carriers (other than African buffalo) initiating new infections in susceptible animals.

The low prevalence of carrier animals in a vaccinated population requires intensive surveillance sampling to prove freedom from disease.

Development of genetically engineered vaccines containing virus protein subunits is in progress but is still in the experimental stages, as is the use of synthetic polypeptide fragments of the immunogenic section of FMDV. A genetically modified FMD vaccine, using a replication-deficient human adenovirus backbone, has recently been conditionally

[11] For further information, see the European Pharmacopoeia (www.edqm.eu/en/european-pharmacopoeia-publications-1401.html).

licensed in the United States. Until further field experience has been obtained for this and other bioengineered and synthetic vaccines, inactivated FMD vaccines that have been tested for safety are currently the best option if vaccination is to be used (Tweddle 2009).

In summary, although vaccination reduces the susceptibility of a population to infection and viral excretion (following subsequent infection of vaccinated animals), it is not a substitute for effective movement controls or biosecurity measures.

1.6 Epidemiology

Key factors in the epidemiology of FMD are as follows:

- The disease is highly contagious, spreading by aerosols and with movements of infected animals and contaminated products, equipment and people.
- Virus is excreted in large quantities in expired air, in all secretions and excretions (including milk and semen), and from ruptured vesicles. Excretion of FMDV can begin up to 4 days before clinical signs become apparent.
- Although FMDV has been isolated from the nose, throat and saliva of people who have had contact with infected animals, the risk of prolonged carriage (more than 24 hours) is considered to be low (Wright et al 2010). There is little evidence to suggest that such people play a significant role in transmitting FMD under field conditions (see Section 1.6.2).
- Cattle are mainly infected by inhalation of contaminated aerosols, whereas pigs are mainly infected through ingestion of contaminated feedstuff.
- Pigs excrete large amounts of virus in respiratory aerosols and, as the main amplifying hosts, are extremely important in disease spread.
- Infected sheep and goats might show mild or inapparent signs and therefore may be important in the undetected maintenance and spread of disease.
- Winds carrying virus can spread the disease over considerable distances under suitable climatic and environmental conditions (see Section 1.6.3). The distances the virus can be carried by wind are potentially greater over water than over land.
- Some recovered cattle, buffalo and sheep (but not pigs) can become carriers, for up to 12 months for cattle and 9 months for sheep. However, there are some anecdotal reports suggesting that, under exceptional circumstances, a small proportion of cattle can harbour virus in the pharynx for up to 3.5 years.
- Camelids are susceptible but are very unlikely to transmit the infection (Fondevila et al 2010).
- Deer are susceptible, but evidence to date suggests that wild and feral populations pose a low risk of transmitting infection to domestic livestock. Deer farmed commercially could potentially be a concern, especially if farmed in high densities.
- Spread of FMD in feral pig populations will largely depend on close contact between groups of pigs.

1.6.1 Incubation period

The OIE Terrestrial Code states that 'the incubation period for foot and mouth disease (FMD) shall be 14 days'.

The length of the incubation period for FMD is highly variable. It depends on the strain and dose of virus, the route of transmission, the animal species involved, individual susceptibility and immune status, and the husbandry conditions under which the animals are kept.

Essentially, the higher the dose or intensity of contact, the shorter the incubation period. With natural routes and high doses of exposure, the incubation period can be as short as 2–3 days; it can be up to 10–14 days with very low doses (Donaldson 1987). When spread is occurring within a herd or flock, the typical incubation period is 2–6 days. For between-farm spread, it is more likely to be 2–14 days (DEFRA 2006).

In pigs, clinical signs can be seen following infection with pig-adapted strains of FMDV within less than 24 hours after exposure in highly contaminated pens. More frequently, clinical signs are seen after 2 days or more, and the incubation period can be as long as 9 days (Kitching and Alexandersen 2002).

In sheep, the incubation period is usually 3–8 days, but can be as short as 24 hours following experimental inoculation, or as long as 12 days, depending on the susceptibility of the animal, the dose of virus and the route of infection (Kitching and Hughes 2002).

See Section 1.4.1 for further information on incubation period, lesion ageing and determining the time of introduction of the virus.

1.6.2 Persistence of agent

General properties

FMDV is small, with no lipid in the envelope. It is susceptible to both acid and alkaline disinfectants (see Section 3.2.10).

The virus has the following general properties (Donaldson 1987):

- The virus is most stable at pH 7.2–7.6 but will survive at pH 6.7–9.5 if the temperature is reduced to 4 °C or lower. Although inactivation times depend on many factors, the FMDV half-life (or, under optimal conditions, the 10-fold reduction time) is approximately 12 hours at pH 6.5, 1 minute at pH 6, and 1 second at pH 5 (Alexandersen 2005).
- Raising the temperature reduces the survival time. At temperatures below freezing point, the virus is stable almost indefinitely. Although there is some variation between strains in resistance to temperature and/or pH stress, exposure to 56 °C for 30 minutes is sufficient to destroy most strains.
- Sunlight has little or no direct effect on infectivity; any loss of infectivity is due to secondary drying and temperature.
- The survival of airborne virus is mainly influenced by relative humidity (RH), with good survival above 60% RH and rapid inactivation below 60% RH (Donaldson 1972).

Environment

FMDV can remain infective in the environment for several weeks and possibly longer in the presence of organic matter, such as soil, manure and dried animal secretions, or on chemically inert materials, such as straw, hair and leather.

See Appendix 3 for other reported survival times under various conditions.

Live animals

Infected animals excrete virus in ruptured vesicular fluid, exhaled air, saliva, milk, semen, faeces and urine. Both clinically affected animals and preclinical animals can shed large quantities of virus (see Section 1.6.3 for further details).

FMDV has been detected in the milk and semen of experimentally infected cattle for 23 and 56 days, respectively (Donaldson and Hofner 1990).

In some ruminants, virus can be intermittently found in the oropharyngeal area more than 28 days after infection, often without the animals displaying clinical disease. These animals are commonly referred to as 'carriers'.

The carrier state is a common sequel for infected ruminants, particularly cattle and African buffalo (*Syncerus caffer*). The duration of the carrier state depends on the individual animal, the animal species and the virus strain. Virus may be recovered in probang samples intermittently but not in excretions such as saliva and semen over that period (Alexandersen et al 2002).

Vaccinated ruminants may also become carriers if exposed to infection, especially in the first few days after vaccination. Neither pigs nor camelids become carriers (Alexandersen et al 2002).

With the exception of transmission of the SAT serotypes of FMDV from African buffalo to cattle (Thomson et al 2003), neither recurrence of disease from carriers nor transmission from wild animal carriers has been demonstrated, despite a considerable amount of research. Important contributing factors with respect to the potential for transmission from wild animals are the FMDV serotype, the population dynamics of the species concerned (including population size, distribution, movement and breeding season), contact with susceptible species of domestic livestock, and the introduction of new and susceptible members (Thomson et al 2003).

Animal products and byproducts

See Appendix 3 for information on FMDV persistence in animal products and byproducts.

Equipment and personnel

People examining the head area of clinically affected pigs (which have higher levels of virus in their air passages than other species) could potentially harbour FMDV in their nasal cavities. Usually the period is 4–5 hours, but in one person virus was recovered after 28 hours (Sellers et al 1970). The risk of prolonged infection (more than 24 hours) of FMDV in the human nasal cavity has been assessed as low (Wright el al 2010) and can be managed by using quarantine periods for people exposed to infected livestock.

Vectors

See Section 1.6.3.

1.6.3 Modes of transmission

FMD is one of the most contagious animal diseases.

Virus is excreted in large quantities in expired air, in all secretions and excretions (including milk and semen) and from ruptured vesicles. Pigs excrete about 1000–3000 times more virus in expired air than ruminants.

Infected, preclinical animals can excrete large amounts of virus. Excretion in semen and milk can occur for up to 4 days before clinical signs appear. Sheep excrete virus in their breath for around 24 hours before signs are apparent (Burrows 1968). High titres of FMDV have been found in such animals. This is of great epidemiological importance: infected animals may be moved, sold and/or slaughtered before clinical disease develops — this has been important in outbreaks overseas and may be the primary cause of disease spread once FMD has been introduced into a country.

Clinically affected animals also shed large quantities of virus. Virus excretion from most sites diminishes rapidly with the appearance of circulating antibodies. Most excretion of virus ceases within 6 days of the appearance of vesicles.

Animals are infected via inhalation, ingestion, and artificial or natural breeding. The primary route of infection of ruminants is inhalation of contaminated aerosols, whereas pigs are mainly infected through ingesting contaminated feedstuff.

Live animals

Transmission occurs most readily when animals are in close proximity, such as at watering and feeding points, stockyards and milking sheds. Movement of infected animals is widely recognised as one of the most important routes by which FMD spreads between herds and farms. Spread of infection between properties and areas is often due to the movement of infected animals or contaminated vehicles, equipment, people and products. The movement patterns of animals in Australia will be a critical factor in the dissemination of FMD.

Spread of FMD in feral pig populations will largely depend on close contact between groups of pigs. This principle is also expected to apply to other feral populations of susceptible species, such as buffalo, deer, camels and goats.

Animal products and byproducts

Meat

Many FMD outbreaks have originated from swill feeding of pigs with infected animal products, or meat scraps and bones from infected animals. Uncooked garbage from foreign ships has been a source of FMD in pigs.

Milk

Unpasteurised raw milk and milk products from infected animals can contain considerable quantities of FMDV. However, although FMDV can survive pasteurisation, there are no reports to date of processed milk, or feeding or transport of processed milk or dairy products, causing disease spread during an outbreak.

Wool, skins and hides

Due to the persistence of the virus on untreated wool, skins and hides, it would be possible for FMD to be transmitted to susceptible animals coming into contact with these products.

Biological products

Outbreaks of FMD have been traced to the use of contaminated biological products, including inadequately inactivated FMD vaccines, vaccinia vaccine, hog cholera vaccine and pituitary extract.

Forage, grain and water

Animals, especially pigs, might become infected by ingestion of contaminated forage, grain, animal products or water, or by licking contaminated objects.

Equipment and personnel

FMDV can be readily spread on contaminated vehicles and equipment, and people can easily transfer infection to animals via contaminated boots, hands and clothing. Spread has been associated with veterinarians, vaccinating teams and rodent exterminators.

Healthy people can harbour FMDV subclinically in the nasal passages and throat for up to 28 hours (see Section 1.6.2).

Milk tankers can become contaminated with FMDV during an outbreak through:

- collection of infected milk from a dairy farm during the preclinical phase of the disease (FMDV can be excreted in the milk of infected cows for up to 4 days before the onset of clinical signs)
- collection of infected milk from a dairy farm during the clinical phase of the disease, when the farmer has either not recognised the clinical signs or has not reported them to the relevant authorities
- physical contamination of the exterior of the vehicle (eg tyres), milk handling equipment (eg milk hose, milk sample bottles), or the driver's hands, clothing and footwear.

Potential risks associated with spillage of contaminated milk and the release of aerosols from milk tankers need to be reduced by following dairy industry biosecurity protocols and using appropriate equipment.

Effluent

Effluent from infected premises (particularly piggeries and dairies) that drains onto roads, stock routes or pastures, or into creeks, can infect or contaminate animals, vehicles, equipment and people coming into contact with it.

Vectors

No biological insect vector has been identified as being important in the spread of FMD (Bachrach 1968). A number of animal species, including humans (Sellers et al 1970, 1971), can act as mechanical vectors for the virus (see above).

Semen and embryos

Experimentally, FMD can be transmitted by insemination with infected semen. FMDV has been found in bull semen 4 days before, during, and up to at least 37 days after, the appearance of clinical signs. The virus enters semen as a result of viraemia or lesions around the preputial orifice.

Transmission of infection via semen has not been reported in sheep or goats, but is likely, given the situation in cattle. FMDV has been recovered from pig semen.

For cattle embryos derived in vivo, FMD has been listed as a Category 1 disease by the International Embryo Transfer Society (IETS). Category 1 diseases or pathogenic agents are those for which there is sufficient evidence to show that the risk of transmission is negligible, provided that the embryos are properly handled between collection and transfer, according to the *Manual of the International Embryo Transfer Society* (4th edition, 2010).

Note that the IETS categorisation applies only to embryos collected, washed and stored according to the IETS manual. Most embryos collected and transferred within Australia are not washed according to IETS procedures; consequently, IETS Category 1 does not apply. Category 1 applies only to bovine embryos imported into Australia.

For sheep, goat and pig embryos derived in vivo, FMD has been listed as a Category 3 disease. Category 3 diseases or pathogenic agents are those for which preliminary evidence indicates that the risk of transmission is negligible, provided that the embryos are properly handled between collection and transfer, according to the IETS manual, but for which additional in vitro and in vivo experimental data are required to substantiate the preliminary findings.

The risks associated with embryos derived in vitro have not been characterised.

See also the **Artificial Breeding Centres Enterprise Manual**.

Windborne spread

'Windborne spread' refers to infection of animals some distance from known foci and without any history of contact with infected animals, through movement of virus on the wind (Donaldson 1983). It is distinct from the short-distance aerosol transmission that commonly occurs between animals.

Under suitable conditions, windborne spread could be involved in the transmission of FMD over several kilometres in Australia (Garner and Cannon 1995). Windborne spread is a complex phenomenon and is affected by:

- the strain of virus, its ability to survive outside the host and its shedding by the host species
- a highly concentrated source of virus — this depends on the species, animal density and the stage of disease in the infected animals; intensively produced pigs may be a particular risk since they produce 1000–3000 times more virus than ruminants
- presence of suitable atmospheric conditions, including steady wind speed and direction, high relative humidity, temperature inversion, and low temperatures and sunlight; favourable conditions may be more likely to occur over water
- local topography and terrain
- density and susceptibility of animals in the exposed area downwind; cattle are most susceptible to infection by windborne spread because of their large tidal volume.

Windborne spread of FMD has primarily been recognised in Europe and was an important feature of the 1967 outbreak in the UK. However, it has not been recognised as an important feature of all FMD epidemics. Due to differences in environmental conditions, animal production systems and livestock densities, windborne spread is considered to be less likely

in Australia than in Europe. Under Australian conditions, other pathways, including the movement of live animals, animal products or fomites, are likely to be more important.

Tactical models have been developed in Australia to assess the risks of windborne spread during an outbreak (Garner et al 2006).

Further information on windborne spread can be found in Donaldson and Alexandersen (2002).

1.6.4 Factors influencing transmission

The extent to which FMD might spread in Australia will depend on climatic factors, the efficiency of detection and diagnosis of early cases, livestock movements and density, biosecurity practices, animal management and marketing, and, possibly, the presence of feral and native animals. Movement of infected animals is widely recognised as one of the most important routes of FMD spread from one premises to another. However, under favourable climatic conditions, movement of airborne virus particles to other properties by wind can be an important factor in FMD epidemics.

Host factors

Species differ in their likelihood of infection with FMDV, their susceptibility to infection by different routes and the amount of virus subsequently shed. The first case of FMD in Australia would probably be in pigs because they are the FMD-susceptible species most likely to be illegally fed FMD-contaminated foodstuffs in the form of swill. Pigs are also highly susceptible to infection by ingestion. If the infected pigs were wild or belonged to a person who is unconcerned about or reluctant to report sick animals, the initial outbreak could well go unnoticed and uncontrolled.

Pigs

Pigs are the major amplifying host for the disease. Although they are primarily infected while ingesting infected feedstuff, pigs are the most efficient producers of virus in respiratory aerosols (Donaldson et al 1970). Thus, spread of FMD from an infected piggery could be rapid and widespread, allowing the disease to gain a substantial foothold before the first clinical cases come to the attention of regulatory authorities. Although it is difficult to mimic field conditions in the laboratory, and the volume of virus excreted by infected animals differs between virus strains (Gloster et al 2008; see Table 1.3), it has been shown that pigs are capable of excreting about 1000 to 3000 times more virus into the air than cattle.

These factors must be considered when determining the size of restricted areas and whether vaccination should be implemented in pigs. For example, if FMD is first detected in a large controlled-environment piggery with air extraction fans, and the atmospheric conditions are favourable for airborne spread of virus, cattle for at least 10 kilometres downwind should be considered at risk.

Table 1.3 Strain differences in amount of airborne FMDV emitted (infectious units per minute)

FMD strain	Cattle	Sheep	Pigs
O_1	57	43	7 140
O_2	4	1.4	1 430
A_5	93	0.6	570
A_{22}	7	0.3	200
$C_{Noville}$	21	57	42 860
$C_{Lebanon}$	6	0.4	260

1 infectious unit = 1.4 TCID50; see glossary
Source: Adapted from Donaldson et al (1970)

Cattle, sheep and goats

Because of their higher respiratory tidal volume, cattle are more susceptible to aerosol infection than sheep or pigs — sheep have one-quarter, and pigs one-twelfth, the infection risk of cattle. Cattle are considered the best indicator species for the presence of FMDV in an area.

Larger cattle herds are more likely to be infected than smaller ones because of the greater probability that at least one animal will inhale an infectious dose (Donaldson 1987). Cattle feedlots, because of their size and species susceptibility, pose a significant risk of becoming infected, and the risk of the infection spreading through the feedlot is increased if slaughtering of infected animals is delayed.

Bos indicus cattle are reported to be less susceptible to infection and disease than European breeds.

Sheep and goats can be important reservoirs of infection because they are usually only mildly clinically affected by FMD, and infection might not be noticed.

Deer

FMD has been reported as a natural infection in several species of deer. Studies in the UK showed that red, fallow and roe deer were all susceptible to experimental infection. Clinical disease was mild or inapparent in red and fallow deer but more severe in roe deer, some of which died. Virus does not commonly persist beyond 14 days in red or roe deer. In fallow deer, virus was isolated from the oropharynx up to 63 days after infection, but not at 91 days (Forman and Gibbs 1974).

The appearance and distribution of lesions were similar to those in sheep — in the mouth and on the feet. Viraemia and seroconversion were more reliable indicators of infection than the presence of clinical lesions.

Livestock production and marketing

Marketing and production systems in Australia can result in the rapid dispersal of animals over wide areas. The ability to trace livestock movements and products is critically important to the early control of an FMD outbreak. The movement patterns of sheep may be particularly important, because they can be infected without showing clinical signs.

In many pastoral areas of Australia, herds of cattle and flocks of sheep are extensively managed. In addition, such cattle herds contain a high proportion of zebu breeds, which tend to show milder signs. FMD might therefore be harder to detect, and spread slowly and insidiously.

From experience of FMD in Africa, spread of the disease in rangeland enterprises is more likely in the dry season, when animals congregate at watering points. On the other hand, infection is less likely to be maintained (because low stocking densities provide limited opportunity for spread), and the disease could die out naturally.

In Australia's more intensively managed areas, livestock populations are denser and in closer contact. Frequent stock movements between individual enterprises and saleyards would facilitate rapid spread of infection over wide areas. Windborne spread might also occur over greater distances in climates that are cooler and wetter. The chances of a rapidly spreading outbreak of FMD are thus higher, but the disease might be more readily detected.

The presence of high-risk enterprises, such as intensive piggeries and feedlots, may influence the spread of FMDV within a region. Large piggeries may have an increased risk of transmission because pigs act as amplifiers of FMDV. Cattle feedlots, which also have large concentrations of animals, represent a special hazard, as the cattle are likely to be more easily infected through aerosols than are extensively grazed cattle.

In some areas, feral animals (pigs, buffalo, goats and cattle) are in close contact with livestock, which can make eradication more difficult (Wilson and O'Brien 1989).

1.7 Manner and risk of introduction to Australia

Historically, Europe and Southeast Asia have been the areas of highest disease threat for Australia because of cultural, ethnic and trade links.

The movement of FMDV strains can now be tracked more easily because of the availability of the sequence of the viral genome. An informative example is the expansion of the Pan-Asia strain of FMDV serotype O, west and east from northern India, where it was first identified in 1990. This strain has now been detected in 28 countries in the Middle East, Europe and Asia. By 2000, the strain had reached Japan, South Korea, the eastern seaboard of Russia and Mongolia — areas free from FMD since 1908, 1934, 1964 and 1973, respectively. The movement of other strains of FMDV has been monitored in Africa, Asia, South America, the Middle East and Europe. In September 2000, FMDV serotype O spread to South Africa via swill fed to pigs. This was the first outbreak of FMD reported in South Africa since 1957, and the origin of the virus was thought to be Asia. In 2010, massive outbreaks of FMDV serotype O (Myanmar 98 strain) across the Southeast Asian mainland in Burma (Myanmar), Thailand, Cambodia, Laos and Vietnam[12] preceded new outbreaks in Japan and South Korea. Southeast Asia has since been identified as the source for the outbreaks in Japan and South Korea (Knowles et al 2012).

The most likely source of infection of the pigs on the index farm of the 2001 outbreak of FMD in the UK was meat or meat products contaminated with FMDV being consumed in unprocessed or inadequately processed waste food originating in Asia (DEFRA 2002). There were subsequent cases in France, the Netherlands and the Republic of Ireland, which were all linked to the British outbreak.

The most significant risk of entry of FMD into Australia is through illegal entry of meat and dairy products. The risk of FMDV-contaminated animal products being imported illegally

[12] See www.seafmd-rcu.oie.int/index.php

has been acknowledged for some time, most recently in the Matthews Report (2011). The virus can survive for long periods in a variety of fresh, partly cooked, cured and smoked meat products, and dairy products that are inadequately heat treated. These could be brought in by passengers on aircraft or ships, or be sent through the post. Garbage discarded by fishing vessels or yachts is another risk.

Swill feeding is illegal in Australia, although the feeding of certain dairy products is allowed in the absence of an FMD emergency response, and the introduction of substantial fines has reduced the risk of FMDV being introduced into the livestock population in this way. The threat posed by illegal swill feeding by small and backyard producers remains.

Australian overseas aid programs include a longstanding FMD eradication campaign in Southeast Asia and China (OIE Southeast Asia and China Foot and Mouth Disease Campaign[13]), which assists Australia to define and address the risk of FMD at source.

The Australian Government also runs the Northern Australia Quarantine Strategy (NAQS), aimed at early detection of exotic disease in high-risk areas of northern Australia. NAQS conducts onshore animal health surveillance for exotic strains of bluetongue virus, and for targeted pests and diseases, including FMD.

1.8 Social and economic effects

The economic effects of an outbreak of FMD, even on a small scale, would be enormous to individuals, the farming industry as a whole, and subsidiary and support industries (Hassall and Associates 1991; Australian Bureau of Agricultural and Resource Economics, pers comm, 2001). Direct effects on Australia's major livestock industries would stem from export market closures and the disruption to production associated with the disease and response activities. There would be significant flow-on losses to many rural and regional businesses that rely on livestock industry revenue — for example, from the impact of movement restrictions on the routine movement of livestock in Australia. In addition, it is expected that there would be indirect effects on sectors such as tourism as a result of customer perceptions and the general downturn of the rural economy.

Overall, the cumulative loss to the national economy was estimated in 2002 to be approximately $2–3 billion in gross domestic product for a short outbreak, rising to $8–13 billion for a 12-month outbreak (Productivity Commission 2002). These figures were revisited by the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) in 2010 as part of the Matthews Report (Matthews 2011). ABARES concluded for 2009–10 that direct economic losses to the livestock and meat processing sector would range from $7.1 billion for a 3-month outbreak to $16 billion for a large 12-month outbreak.

During the 2001 UK FMD outbreak, the cost to tourist revenue surpassed the overall response costs — including compensation payments, government and contractor costs, and support for affected businesses. The impact on tourism is unlikely to be so extensive in Australia.

The direct impacts of an FMD outbreak in Australia would include a contraction in economic activity, particularly in the pastoral, livestock and meat-processing industries,

[13] www.seafmd-rcu.oie.int/index.php

resulting in an estimated 0.5% loss in employment in the first year of an outbreak (Productivity Commission 2002).

The likely fall in agricultural exports would be large enough to affect the exchange rate. The value of the Australian dollar would fall by an estimated 2.5% during the first year, and remain below pre-FMD levels for 9 years (Productivity Commission 2002).

There would also be significant social costs. At the individual and family level, the social impacts could range from strains on family relationships to severe mental disorders. At the community level, impacts could range from a breakdown of normal community activities, in the midst of quarantine and movement restrictions, to changes in interpersonal relationships, affecting longer term community cohesion.

Other issues that can be expected to contribute to social and economic costs include debates regarding value and ethics of slaughtering large numbers of healthy livestock and perhaps wildlife, consumer misconceptions regarding the safety of product from vaccinated animals, and environmental concerns about burial and/or burning of carcasses and products.

Media and other communication strategies will be central to managing these issues.

The extent of the socioeconomic impacts will depend on reactions of trading partners, particularly if zoning is implemented so that some market access can be maintained. The likelihood of zoning being acceptable to trading partners would need to be considered before valuable resources are allocated to this strategy (see Section 3.2.4).

For Australia to be recognised by the OIE as having regained its FMD-free status as quickly as possible (ie in 3 months rather than 6 months, provided that appropriate proof-of-freedom surveillance has been completed and documented), it would be necessary for a stamping-out policy to apply and, if vaccination were to be used, for all vaccinated animals to be removed from the population, consistent with the OIE Terrestrial Code. However, affected export markets are likely to take longer to recover after the re-establishment of a disease-free status because market access will depend on bilateral negotiations, which could be protracted. Thus, the costs versus benefits of removing vaccinated animals from the population during, or immediately after, the outbreak will need to be considered.

1.9 Criteria for proof of freedom

Any application to the OIE regarding recognition of FMD freedom should be based on the OIE Terrestrial Code chapters on FMD (Chapter 8.5)[14] and general surveillance (Chapter 1.4),[15] as well as the OIE FMD questionnaire (Article 1.6.4).[16]

Reinstatement of official FMD-free status will require the submission of a formal report to the OIE, detailing the eradication procedures carried out, the surveillance program and the results obtained.

See Appendix 2 for further information on proof of freedom.

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14 www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm
15 www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.1.4.htm
16 www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.1.6.htm

2 Principles of control and eradication

2.1 Critical factors assessed in formulating response policy

Features of foot-and-mouth disease (FMD) include the following.

2.1.1 Organism

- FMD is one of the most contagious animal diseases and can affect a wide range of livestock species.
- FMD causes significant production losses, including neonatal mortality, in clinically affected animals.
- Infected animals excrete large amounts of virus in ruptured vesicular fluid, exhaled air, saliva, milk, semen, faeces and urine (including for up to 4 days before clinical signs appear).
- FMD is spread most efficiently by the movement of live, infected animals. It can also be spread rapidly over long distances by movements of contaminated animal equipment, vehicles and people.
- FMD will rapidly spread through high-density populations such as intensive pig operations, feedlots and dairy farms.
- The weather conditions at the time of the outbreak, the species infected and the viral strain will determine the survival of airborne virus and how far it spreads. Windborne spread can occur for many kilometres under the right conditions. The virus is likely to survive longer in cool, moist, temperate conditions than in hot, dry, desert conditions.
- Foot-and-mouth disease virus (FMDV) can remain infective in the environment for several weeks to months in the presence of organic matter, such as soil, manure and dried animal secretions, or on chemically inert materials, such as straw, hair and leather.
- Tests are available for the rapid detection of FMD infection.

2.1.2 Susceptible populations

- Pigs are the major amplifying host for the disease. Many FMD outbreaks have originated from swill feeding of pigs with infected animal products.
- Cattle are the major clinical indicator species. Sheep and goats often show only mild or no signs, and this may delay the initial diagnosis.
- Initially, cattle are mainly infected by inhaling contaminated aerosols and pigs by ingesting contaminated feedstuffs. In pigs, direct contact then becomes the major transmission route within groups.
- Some recovered cattle, buffalo, goats and sheep can become carriers; however, despite a number of anecdotal reports, as yet, there is no confirmed evidence that outbreaks have originated from carriers, apart from African buffalo.
- Not all susceptible animals are capable of transmitting disease (eg camelids are unlikely to transmit infection).

- Smallholder cattle, sheep, goat, deer and pig populations may not be easily identified or located. Smallholders may not recognise or report the disease, or seek assistance.
- Animals owned by smallholders are more likely than those owned by commercial livestock producers to be exposed to emergency animal diseases, due to their locations, biosecurity practices, relative lack of quality assurance programs, and so on (Perkins et al 2010).
- Overall, most of the risk of emergency animal disease outbreaks is associated with commercial livestock producers, rather than smallholders, because of their far greater numbers of animals and animal movements (Perkins et al 2010).
- Remote locations can delay the initial diagnosis.
- The role played by feral susceptible species in virus transmission is largely determined by their population densities and level of interaction with domestic susceptible species.
- Rare breeds, animals with valuable genetics and endangered species (such as animals in captive breeding programs) could be vulnerable to the impacts of FMD control activities. Archiving of genetic material is possible for most of these animals.
- Intensive pig production systems are prone to rapid overcrowding if output is disrupted, resulting in animal welfare concerns.

2.1.3 Products

- FMDV is inactivated in the meat of carcases that have undergone normal post-slaughter acidification to a pH of less than 6.2. This can occur within 3 days. If inactivation has not occurred, fresh, cured and salted meats provide an important route of introduction.
- With regard to inactivation of FMDV in milk, although the virus can survive pasteurisation, there are no reports of processed milk, or feeding or transport of processed milk or dairy products, causing disease spread during an outbreak.
- In parts of Australia during peak lactation, milk processors' storage and processing facilities operate at full capacity. Any delays in processing milk will result in a buildup of milk in tankers and on farms.
- FMD can be transmitted by semen, and identification and traceability of semen from susceptible species is important.

2.1.4 Stamping out

- Destruction of infected and suspect infected animals should be completed as rapidly as possible to reduce shedding of the virus and spread of disease.
- Destruction requires the operators to have formal licensing, registration and/or competencies, and may require airspace notification.
- Topography, prevailing weather and permit requirements (fire, environment, conservation and heritage) limit disposal options.
- On-site disposal requires decontamination of heavy machinery.

2.1.5 Vaccination (see also Appendix 5)

- Vaccination can be used to protect animals from clinical disease, reduce the probability of infection, and reduce the amount of virus excreted if animals become infected.
- Under some circumstances, vaccination may reduce the duration of the outbreak.

- Vaccination may be part of an emergency response aimed at eradication. However, it is not a substitute for movement controls and biosecurity measures.
- Vaccination should be considered as one of the potential strategies for disease control on the day an FMD incursion is detected.
- Vaccination may be useful for a range of purposes during FMD outbreaks. Types of vaccination that might be considered include, but are not limited to, protective vaccination, suppressive vaccination and mass (blanket) vaccination (see Appendix 5 for more details).
- Whether to vaccinate and how to apply vaccination are complex decisions that will depend on many factors, including the nature of the outbreak, epidemiological considerations, logistical and resourcing issues, animal welfare considerations, industry and public attitudes, socioeconomic considerations, trade implications, international standards and international experiences with the use of vaccination in previously free countries.
- Australia maintains an arrangement for a bank of antigens to a number of FMDV strains and the ability to rapidly produce vaccine to those strains, if required.
- If Australia decides to use vaccine, there may be some delays due to the time required to characterise the virus, source the vaccine from the bank, distribute the vaccine and vaccinate animals, and for the animals to develop an immune response.
- Delays in implementing a vaccination strategy may affect its ability to limit the spread of infection.
- To be highly effective, vaccines must be closely matched to the outbreak strain. The field strain of FMDV can mutate during a prolonged outbreak.
- Importation of FMD vaccines is subject to the issuing of import permit(s) from the Australian Government Department of Agriculture. Supply and use of the vaccine in Australia will require an emergency permit and consent to import from the Australian Pesticides and Veterinary Medicines Authority (APVMA).
- Importation, distribution, use and disposal of a vaccine that is a genetically modified organism must also be licensed by the Office of the Gene Technology Regulator or permitted under an Emergency Dealing Determination by the minister responsible for gene technology.
- Full reconciliation will be required for all vaccines distributed.
- The extent of cross-protection between strains of FMDV within the same serotype depends on the similarity of their antigens. There is very little to no cross-protection between different serotypes.
- Reduction of clinical signs and decreased virus excretion by vaccination are influenced by the time between vaccination and infection, the vaccine potency, the animal species, the response to vaccination by the animals' immune system, the strain of FMDV, and the homology between the vaccine strain and outbreak strain.
- Serological tests that differentiate between infected and uninfected vaccinated animals (DIVA tests) have been validated for cattle at the herd level, and are also available for sheep, goats and pigs (although these are less well validated).
- Biosecurity measures practised by all field teams are critical to the success of a vaccination program.

- Until vaccinated animals have been tested to rule out infection, vaccinated premises outside a restricted area should be subject to the same movement controls and biosecurity as those within the restricted area.
- Lifetime traceability of vaccinates is necessary for ongoing surveillance and proof of freedom.
- Cost comparisons between various control strategies must include the cost of surveillance for proof of freedom. Proof-of-freedom surveillance will need to be undertaken regardless of the eradication strategy used.

2.1.6 Social, economic and political factors

- FMD is the single biggest threat to Australia's livestock industries, and an outbreak would cause far-reaching economic and social disruption to many parts of the community, including increased unemployment in the rural sector.
- Re-establishment of trade for affected industries will be one of the highest priorities of disease response efforts.
- Production losses, management costs and trade impacts from an outbreak of FMD in Australia are expected to be significant.
- The expected severe market disruption will reduce the value of all related industries and affect others, such as tourism and hospitality.
- The economic impact of FMD on export and domestic markets will exceed the costs associated with eradicating the disease.
- Smallholders may have little knowledge of disease control issues such as swill feeding regulations and the need to report illness in their animals. Fear of repercussions may deter them from reporting disease.
- Cooperation and support from the public, industry and other stakeholders are vital to success of an eradication program.
- Support and recovery measures must be sufficient to counter any financial disincentives for producers to cooperate with disease control strategies.
- Considerable public concern can be anticipated over the mass culling of large numbers of healthy at-risk animals. Vaccination may partially reduce this concern.
- The management of vaccinated animals will need careful consideration, to minimise potential social and financial ramifications.
- Domestic consumption of products from vaccinated animals might be affected by public health fears, especially if meat or milk from the restricted area is marketed.
- In addition to the OIE guidelines on regaining a country's FMD-free status following an outbreak, including specified waiting periods and the satisfactory completion of activities such as serosurveillance, bilateral trade negotiations and independent assessments performed by other countries may also influence the time taken to resume trade.

2.1.7 Legal issues

- As noted in Section 2.1.5, importation of vaccine will require an import permit from the Australian Government Department of Agriculture. Supply and use of the vaccine in Australia will require a permit from the APVMA. Both permits are in place as part of preparedness for an FMD outbreak. A consent to import from the APVMA will also be required at the time of import.

- Rapid imposition of regulatory controls on livestock movement and feed may be required in the initial stages of an outbreak.
- Movement restrictions and other controls will require a large permitting and enforcement effort. Permits will be issued only under specific conditions, and often based on a risk assessment.
- Swill feeding is not permitted in Australia, and the introduction of substantial fines has reduced the risk of introduction of FMD into the livestock population by this route. In the event of an outbreak, jurisdictions will need to ensure the removal of any exemptions (such as milk) from what constitutes 'swill' in declared areas.
- A Council of Australian Governments (COAG) memorandum of understanding (MoU) describes a national coordination framework for responding to an outbreak of FMD.[17]
- The COAG MoU provides for relief and recovery measures, which continue after disease control and eradication operations have wound down.

2.1.8 Potential communication messages

- There is no public health risk from consumption of meat or animal products.
- The AUSVETPLAN Disease Strategy for FMD (this manual) sets out the suggested starting policy and guidelines for agencies and organisations involved in a response to an outbreak of FMD in Australia.
- Initial stamping out is necessary to minimise the impact of the disease on other livestock in Australia.
- Stamping out will be conducted humanely.
- Movements of live animals pose a risk of spread of the disease.
- If vaccination is used, there is no public health risk from the consumption of product from vaccinated animals.
- Undertaking recommended biosecurity measures such as movement restrictions is vitally important.
- Milk treated for human consumption is not suitable for susceptible livestock. (Public messages will need to explain why this is the case, and link to the prohibition of swill feeding.)

2.1.9 Zoning for international trade

- Zoning for market access purposes could be considered as part of the FMD response plan where:
  - the epidemiology of the outbreak is known well enough to provide confidence that large regions of Australia are uninfected (ie the 'free' zone), it is possible to maintain that status with confidence, and resources required to establish and maintain the free zone are available and do not disadvantage the stamping-out response; if a containment zone is possible (as defined in Article 8.5.8 of the OIE Terrestrial Code), further resourcing will also be required (see Section 3.2.4)
  - implementation of border controls at the boundary of the free zone is practical

[17] www.coag.gov.au/node/50

  - it is possible for the free zone to prevent imports of livestock and livestock products from an infected or containment zone
  - a cost–benefit analysis for zoning may be considered.
- Because zoning will require considerable resources that could otherwise be used to control the outbreak, careful consideration will need to be given to prioritise these activities. In practice, zoning is unlikely to be considered for some time into an outbreak, and any benefit from zoning will be subject to bilateral agreement between the veterinary services of Australia and its trading partners (see Section 3.2.4).

2.2 Options for control or eradication based on the assessed critical factors

Based on the identified critical factors, options for control or eradication of FMD are:

- stamping out without vaccination
- stamping out with vaccination
  - with mandatory destruction of all vaccinates (either slaughter or on-farm destruction and disposal) before declaration of freedom
  - with no mandatory destruction of vaccinated animals, but with control measures, including lifetime traceability, in place
- control of endemic infection, at least in defined zones, with vaccination in the short to medium term to control transmission and/or protect uninfected populations.

The policy to be implemented is described in Section 3.

3 Policy and rationale

3.1 Introduction

Foot-and-mouth disease (FMD) is a World Organisation for Animal Health (OIE)-listed disease and represents the greatest disease threat to Australia's livestock industries and export markets. It has the potential for rapid and extensive spread, and an outbreak would jeopardise the export of all cloven-hoofed animals and their products, at least in the short term.

Case definition

FMD should be considered in the differential diagnosis of a case whenever vesicles are seen in cloven-hoofed animals, including camelids. A provisional diagnosis of FMD should be made when there is a combination of two or more of the following clinical signs:

- acute lameness in a group of animals
- excess salivation
- vesicles in the mouth, on the feet and/or on the teats
- fever
- a considerable drop in milk yield (in dairy species).

In sheep, clinical signs are usually milder and more subtle than in other species, such as pigs and cattle. For sheep, close veterinary physical inspection of mouths and hoofs is often required to identify vesicles.

The OIE case definition for FMD is an animal infected with FMD virus (FMDV); this can be in either the presence or absence of clinical signs. The OIE defines the occurrence of FMDV infection as:

- FMDV has been isolated and identified as such from an animal or a product derived from that animal; or
- viral antigen or viral RNA specific to one or more of the serotypes of FMDV has been identified in samples from one or more animals, whether showing clinical signs consistent with FMD or not, or epidemiologically linked to a confirmed or suspected outbreak of FMD, or giving cause for suspicion of previous association or contact with FMDV; or
- antibodies to structural or nonstructural proteins of FMDV that are not a consequence of vaccination have been identified in one or more animals showing clinical signs consistent with FMD, or epidemiologically linked to a confirmed or suspected outbreak of FMD, or giving cause for suspicion of previous association or contact with FMDV.

A definitive diagnosis would be based on confirmed laboratory identification of FMDV at the CSIRO Australian Animal Health Laboratory, by virus isolation or other methods (see Table 1.2). In the absence of clinical signs, serological positives would require investigation to clarify the situation.

Summary of policy

FMD is a Category 2 disease under the *Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses*. Category 2 diseases are those for which costs will be shared 80% by government and 20% by industry.

The policy is to eradicate FMD in the shortest possible time, while minimising economic impact, using *stamping out* supported by a combination of strategies.

Initially, the response to FMD consists of:

- **an *immediate assessment of the epidemiological situation***
- ***rapid recognition* and laboratory confirmation of cases**
- **an immediate national *livestock standstill* (refer to Section 4.1.1) following diagnosis or strong suspicion of FMD, so that epidemiological information can be gathered and collated, and the potential extent and possible impacts of the outbreak can be assessed**
- ***implementation of legislated declared areas* for disease control purposes**
- ***quarantine and movement controls* over animals, animal products and fomites in declared areas, to minimise spread of infection**
- ***typing of the outbreak strain of virus and ordering of appropriate vaccine***
- ***tracing and surveillance* to determine the source and extent of infection (including, as necessary, in feral animals)**
- ***valuation and destruction* of animals on infected premises and potentially on dangerous contact premises**
- ***disposal* of destroyed animals and infected animal products, and *decontamination* of infected premises and dangerous contact premises**
- ***decontamination and/or disposal* of fomites to eliminate the pathogen**
- ***recall* of animal products (including dairy products for animal consumption, etc) likely to be contaminated (unless deemed unnecessary by a risk assessment)**
- ***relief and recovery programs* to minimise animal and human welfare issues that could inhibit the effectiveness of the response**
- **a *public awareness campaign***
- ***industry support* to improve understanding of the issues, facilitate cooperation and address animal welfare issues.**

Additional measures may be taken if authorities consider that they would be beneficial in containing and managing the outbreak, including:

- ***vaccination* to reduce susceptibility of animals to infection and clinical disease, and potentially reduce virus excretion**
- ***pre-emptive destruction* of susceptible animals to minimise spread of infection**
- ***zoning and/or compartmentalisation* (where appropriate)**
- ***risk-based movement controls* (eg extending to milk and other commodities).**

Following a prescribed period after the last diagnosis or vaccination, the final stages of the response will include:

- ☞ ***surveillance for proof of freedom*** **from disease (see Appendix 2).**

These strategies and policy guidelines are for emergency situations, and are not applicable to quarantine policies for imported livestock or livestock products.

The chief veterinary officer (CVO) in the state or territory in which the outbreak occurs is responsible for developing an Emergency Animal Disease (EAD) Response Plan for the particular outbreak.

The Consultative Committee on Emergency Animal Diseases (CCEAD), convened for the incident, assesses the response plan drawn up by the affected jurisdiction's CVO for technical soundness and consistency with AUSVETPLAN, and endorses it or seeks modifications to it. The CCEAD may also ask unaffected jurisdictions to develop response plans to address activities in the jurisdictions that will be cost shared. Overall operational management of the incident rests with the CVO of the affected jurisdiction, with oversight by the CCEAD.

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

The Council of Australian Governments (COAG) memorandum of understanding (MoU) — National Response to a Foot and Mouth Disease (FMD) Outbreak[18] — provides a national coordination framework for responding to an outbreak of FMD, including consideration of relief and recovery, which continues after disease control and eradication operations have wound down. The Australian Government Agricultural Incident Plan[19] also provides guidance to Australian Government agencies that are likely to participate in coordinating a response to an incident affecting agricultural industries.

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

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

For information on the responsibilities of the state coordination centres and local control centres, see the **Control Centres Management Manual**.

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[18] www.coag.gov.au/node/50

[19] Initially called the Agricultural Emergency Plan, the Agricultural Incident Plan covers incidents affecting agricultural industries, including effects on animal health and welfare, aquatic animal health, plant health, introduced marine pests, food safety, bioterrorism and other relevant agricultural issues. The plan is currently being revised to reflect contemporary emergency management practices.

3.2 Control and eradication policy

The default policy for an outbreak of FMD is to contain, control and eradicate the disease to re-establish the FMD-free status of Australia as quickly as possible, while minimising social and financial disruption. This will be accomplished through stamping out, supported by a number of other strategies, as outlined in Section 3.1.

The primary objectives of the policy are to prevent:

- contact between infected and susceptible animals
- production of large volumes of virus by infected animals
- indirect spread of virus by people and fomites.

These objectives can best be achieved through quarantine and movement controls, stamping out of infected and suspect animals, and efficient tracing and surveillance. If appropriate, the response will include strategic use of vaccine in accordance with international standards. Zoning for international trade may also be considered (see Section 3.2.4).

The key issue in considering the most effective strategies for management of an FMD outbreak is the extent to which the disease can be controlled with available resources and, in particular, whether to apply vaccination as a tool to assist in eradication of the disease. This will largely be determined by the location of the outbreak, the time since FMD was introduced, and the extent to which the disease has spread across and within industry sectors. Eradication by stamping out may be feasible if the disease was introduced relatively recently and occurs on circumscribed properties. In contrast, control may be more difficult for an outbreak in a high-density livestock production area where there is already evidence of spread across and between different industry sectors (see FMD vaccination decision tree, Appendix 5).

The potential for feral and wild animals to compromise containment and eradication needs to be assessed and appropriately managed, consistent with the **Wild Animal Response Strategy**.

A large, proactive and well-considered communications and liaison exercise will be required to address concerns of affected groups, the media and the public.

Remote areas

In remote areas, low stocking rates and low contact rates will mean that rapid spread is unlikely in cattle and buffalo, except at the end of the dry season when animals congregate around waterholes.

If FMD is diagnosed in extensive cattle production areas in the north of Australia, special control measures might be needed where logistical considerations do not allow the rapid destruction and disposal of cattle and buffalo. If field shooting of cattle, pigs, buffalo or other species is required, a feral population reduction program may also need to be considered (refer to the **Wild Animal Response Strategy** for more information).

3.2.1 Stamping out

Stamping out will be the default policy initially, as it is the quickest method to reduce viral excretion on infected premises (IPs).

The aim of stamping out is to ensure that IPs are quarantined (to contain infection on the premises) and susceptible animals are destroyed to limit the spread of the virus. Stamping out should be completed as soon as possible. It will be implemented on all IPs, and potentially on dangerous contact premises (DCPs), subject to risk assessment. Animals on suspect premises (SPs) and trace premises (TPs) must be assessed as soon as possible to enable these premises to be reclassified (and appropriate action taken). Tracing and surveillance will play a critical role in identifying infected and in-contact animals to determine the extent of the restricted areas (RAs), control areas (CAs) and outside areas.

Animals that are considered to be most infective will be given priority for destruction, in accordance with the **Destruction of Animals Manual**. Clinically infected animals should be destroyed first to reduce virus excretion. Where possible, infected pigs should be destroyed before cattle, and cattle before sheep (based on the volumes of virus excreted by each species). Clinically infected animals will be followed by susceptible animals presenting the next highest risk, such as those in direct contact with clinical cases.

Operators involved in destruction require formal licensing, registration and/or competencies, and will be under the direction of local control centres.

3.2.2 Quarantine and movement controls

Australia will implement a national livestock standstill from the time of diagnosis of FMD or on strong suspicion of the disease. The standstill will be triggered by the NMG acting on the advice of the CCEAD. It will apply only to FMD-susceptible animals (not their products) and will be implemented for at least 72 hours. However, during the livestock standstill, jurisdictions may impose movement controls over other products (including meat, carcases and/or offal) and equipment (see also Section 4.4). A decision to ease, lift or extend the standstill will be based on risk assessment, taking into account surveillance findings and the known epidemiology of the outbreak.

RAs and CAs will be established to ensure rapid and effective containment of the disease, and to clearly define infected and outside areas.

All IPs and DCPs will be quarantined, with no movement in or out of live susceptible animals during surveillance and inspections. For SPs and TPs, there will be no movement in or out of live susceptible animals until the status of the premises has been clarified. Appropriate movement controls will be imposed on declared premises to ensure that any product likely to be contaminated is appropriately dealt with through treatment or destruction.

Once the livestock standstill has been lifted, movement of animals, vehicles and products from at-risk premises and premises of relevance will be managed according to conditions specific to the declared area.

The RA will be based on a minimum 3-kilometre radius around the IP. This will be modified as tracing and surveillance results become available and wildlife distributions are better defined. It is essential that the IPs and DCPs, and as many SPs and TPs as possible, are included within the RA.

The potential for windborne spread will be taken into account when determining the size and shape of an RA, using Bureau of Meteorology advice and tactical models developed for assessing the risk of windborne spread under outbreak conditions (Garner et al 2006). These models provide a guide to the potential spread of FMDV, but are not definitive and should be used with caution.

The RA should be consistent with the overall objective of eradicating FMD in as short a time as practicable while minimising the economic impact. Minimising the size of the RA reduces the number of farms under the most stringent controls. However, it is important to note that overseas experience suggests that an initial conservative approach in defining declared areas (ie overstating rather than understating their size) is important to avoid missing critical movements that could spread disease.

The CA, at least in the initial stages, will be based on state or territory borders, which are easily recognisable and understood by the local and international community. These boundaries will be reviewed as epidemiological information becomes available, but the CA will probably still be based on local government areas (eg shires, parishes). Any reduction in the size of the CA will lead to less demand for resources and enable better management of animals and product movement. The CA will have a minimum radius of 10 kilometres, including the RA.

Refer to Section 4 for further details of movement controls on animals and animal products.

3.2.3 Tracing and surveillance

Tracing

Rapid trace-back and trace-forward are essential to effectively contain the disease.

Trace-back will be applied for a minimum of 14 days before the onset of clinical signs. Trace-forward will be applied for a minimum of 14 days before the first reported case (index case) and up to the time that quarantine is imposed.

Tracing will include:

- susceptible species
- animal products — meat, offal, dairy products, wool, skins, hides, semen and embryos, and wastes and effluent (including any evidence of illegal swill feeding)
- vehicles — milk tankers, livestock transport vehicles, feed trucks, farm visitors' cars, local government cars (eg rangers), and other rural industry vehicles such as those of forestry contractors
- materials — hay, straw, crops, grains and mixed feed
- people — people who live on the property, veterinarians, vaccination teams, tanker and other vehicle drivers, artificial insemination personnel, sales and feed representatives, tradespeople, technicians, visitors and other rural industry contractors.

Tracing should also include consideration of potential exposure to virus through windborne spread and contact with wild or feral animals (pigs, goats and deer). This should include consideration of environmental and geographical factors, and the relative ability of the species to transmit infection. Follow-up investigation of premises identified by tracing should be prioritised by the likelihood of transmission and the potential consequences for disease control activities.

The first reported IP (ie the property with the index case) might not be the first infected property (ie the property with the primary case). Trace-back from the index case may identify earlier cases, including the primary case, and assist in establishing the route of entry of FMD into Australia. The detection of infection in ruminants should immediately raise the question of whether an unidentified infected pig farm could be the location of the primary case.

Information management systems should be used to support tracing activities, as well as examination of farm records and interviews with farm workers and/or managers. Databases for the National Livestock Identification System (NLIS) and documents such as National Vendor Declarations (NVDs) or Animal Health Statements should be used to assist with tracing and epidemiological investigation.

Dairy products

When FMD is confirmed on a dairy premises, a tracing exercise must be conducted to determine the disposition of raw milk that has left the IP during a minimum period of 14 days before the first suspected case on the premises. Tracing must also be conducted for milk tanker movements during the same period.

If initial tracing determines that raw milk has been commercially processed to Standard 1 for human consumption (see Section 3.2.7), it does not need to be further traced unless it has been diverted to animal feed, in which case tracing is required, and trace-forward investigations will be carried out.

The risk of raw milk commercially processed to Standard 1 being fed to FMD-susceptible animals can be addressed through:

- swift introduction of legislation, if not already in place, to ban feeding of dairy products to pigs and other FMD-susceptible species
- heightened public awareness messages and campaigns
- verifying waste disposal chains, particularly for dairy plant effluent and out-of-date milk, which are sometimes fed to pigs.

If tracing identifies that milk from IPs has been directed to animal feed, the milk or feed must be recalled, and should not be provided to FMD-susceptible animals.

The Australian Government Department of Agriculture will work with export establishments to determine whether milk products derived from affected milk were certified appropriately for export. The Australian Government Department of Agriculture will notify importing countries of any affected consignments and manage them as required by the importing government authority.

Surveillance

Surveillance during an FMD outbreak will initially be aimed at:

- detecting new outbreaks
- defining the extent of infection
- demonstrating that infection is not present in the CA and outside area (OA).

This will be achieved by investigation of SPs, TPs and DCPs (if not culled immediately), and surveillance of at-risk premises (ARPs) in the RA and premises of relevance (PORs) in the CA. Prioritising of surveillance should be risk based and take into account the apparent rate of transmission and profiles of susceptible species in the local context. Surveillance may also occur outside declared disease control areas (ie in the OA), to follow up on traces and investigate suspect case reports. Additional surveillance would be required if a decision were made to undertake zoning or compartmentalisation for international trade purposes (see Section 3.2.4).

Surveillance activities must include procedures to:

- incorporate appropriate surveillance regimes for properties with different premises statuses
- quarantine temporarily classified premises (SPs and TPs) until their premises status is resolved
- ensure that property investigation of SPs is a high priority
- prevent disease spread by surveillance activities
- prevent unnecessary property visits
- ensure that all properties with susceptible species within RAs and CAs are recorded on the information management system as soon as practicable, so that surveillance and tracing schedule reports can be generated
- ensure that surveillance staff report, debrief and provide samples according to a schedule that minimises delays in laboratory diagnosis.

Communication strategies targeted at veterinarians and livestock owners should focus on decontamination, safe stock inspection and sampling techniques. A strong culture of strict biosecurity must be engendered to ensure that the contagious nature of FMDV is understood.

Surveillance activities may be amended as the epidemiology of the outbreak becomes clearer.

For further information on general aspects of surveillance, see Section 3.2.13 (wild animal, feral animal and vector control), Section 1.6.3 (windborne spread) and Appendix 2 (surveillance and proof of freedom).

Surveillance of SPs, TPs and DCPs

Surveillance of SPs, TPs and DCPs should include clinical inspection of livestock by surveillance teams. Where required, laboratory samples may be taken to support such investigations.

Surveillance teams should be provided with information from laboratories to ensure that appropriate samples are taken. To avoid data omissions, detailed information on each SP and TP should be collected.

Information from investigations of SPs and TPs must be entered into the relevant database as a high priority so that control centre personnel can plan for changes in designated disease control areas (in RAs and CAs), develop surveillance schedules and plan to allocate resources. The relevant information management system should be operational from the alert phase, allowing the first and subsequent surveillance situation reports to be produced from the system.

Debriefing procedures for field teams should be in place.

Surveillance of ARPs in the RA

Surveillance within the RA will be primarily by inspection of livestock by both owners and control centre veterinarians. The person(s) responsible for the stock should ensure that the stock are examined daily, if possible. Communications messages should provide information to livestock workers and owners about inspection procedures, clinical signs of disease and who to contact so that suspect cases are investigated. To facilitate inspections by

surveillance staff, owners should be encouraged to aggregate animals of the same management group, where possible, and ensure that they have ready access to yards for close examination, if necessary. This will increase the efficiency of surveillance teams.

The frequency of inspections by veterinary surveillance staff will depend on the assessed risk (including from airborne transmission), the size of the RA and the available resources. Each property within the RA should be considered to be potentially incubating the disease, and surveillance teams should follow strict decontamination procedures when entering and leaving premises (refer to NASOP 26: Decontamination of groups of people—entry and exit procedures[20]). Each surveillance team (or single veterinarian) should be allocated a small number of properties for which they are responsible for managing surveillance and biosecurity.

Surveillance of premises adjacent to an IP should occur frequently to ensure that premises incubating infection are quickly identified. Results of this surveillance can also be used to determine the degree to which transmission occurs across farm boundaries, and determine the relative importance of windborne spread, spread by close contact between animals and spread by fomites.

Surveillance of PORs in the CA

The initial CA is likely to be very large (possibly covering a whole state), presenting challenges for effective management of active surveillance. Surveillance within the CA may also involve abattoir surveillance and investigation of reports of suspected disease. Serological surveys may be undertaken in the proof-of-freedom phase (see Appendix 2). For logistical purposes, it may be useful to separate management and resourcing of surveillance in the CA from that in the RA.

3.2.4 Zoning and compartmentalisation for international trade

The OIE sets international standards for the improvement of terrestrial animal health and welfare, and veterinary public health worldwide, including standards for safe international trade in terrestrial animals and their products.

Under OIE guidelines, zoning offers the opportunity to divide an infected country into zones with different disease statuses, to facilitate trade. Zoning can be applied in two ways: for widespread outbreaks and for limited outbreaks. The OIE guidelines for FMD are in Chapter 8.5 of the OIE Terrestrial Code.[21]

Compartmentalisation is a principle developed by the OIE to divide industry production into subpopulations of different disease statuses for trade purposes. Although compartmentalisation is described in the OIE Terrestrial Code as a tool suitable for use in a response to FMD, there is little experience with its practical application. Therefore, this section focuses on zoning.

This AUSVETPLAN disease strategy seeks to explain the implication of zoning to limited and widespread outbreak scenarios. In cases where outbreaks are limited, epidemiologically linked, geographically proximate and/or contained, the OIE Terrestrial Code provides for

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20 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Decontamination-of-groups-of-people-entry-and-exit-procedures.pdf

21 www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm

the establishment of a containment zone to minimise the impact on the entire country or zone (Article 8.5.7; see Appendix 4).

For both limited and widespread outbreaks, a zoning application would need to be prepared by the Australian Government in conjunction with the relevant jurisdiction(s). The application would need to meet the OIE standards **as a minimum**. The application may receive endorsement, but the recognition of zones is not an overarching international agreement. When the OIE assesses that the standards have been met, Australia's veterinary authority[22] would begin bilateral negotiations with trading partners. In practice, any trade benefit from zoning will be subject to bilateral agreement between the veterinary services of Australia and its trading partners.

Agreements between trading partners will take time to develop, consider and finalise. This time is related to the provision of detailed information, costing and resourcing, and national frameworks to underpin the approach that is developed. An importing country will need assurance that its animal health status is not compromised if it imports from an established FMD-free zone in Australia. It is not known how Australia's trading partners would react to a zoning proposal. Although a number of countries perform independent assessments, other countries adopt the OIE criteria for freedom. Some countries may not accept 'zone freedom'.

The importing country would evaluate Australia's veterinary services, conduct a risk assessment and evaluation of the effectiveness of such zones, and consider its legislation and status with respect to FMD and other relevant OIE standards. The provision of information for this process will be resource intensive and time consuming, and acceptance by the importing country is not guaranteed. Eradication may be achieved before a decision on a free-zone application is reached.

Zoning will require considerable resources that could otherwise be used to control an outbreak, and careful consideration will need to be given to prioritise these activities; for example, if resources are withdrawn from the response in the containment zone (to resource border controls and surveillance in the established free zone), this could delay the quick eradication of the disease and the recognition of FMD freedom. The establishment of a free zone should include consideration of such competition for resources. It would be prudent to establish a free zone away from the containment zone so that there are quite distinct and effective geographical borders and/or isolation, ensuring that the free zone operates independently. The establishment of a free zone is likely to involve duplication of the existing national quarantine system at the perimeter of the zone.

Managing disease-free zones is a responsibility of veterinary authorities.

See Section 4.1.3 for further details on declared areas, Section 4.4 for quarantine and movement controls, and Appendix 4 for zoning for international trade.

3.2.5 Vaccination

Vaccination is one of the available options to support stamping out of an FMD outbreak.

[22] Australian Chief Veterinary Officer or the Australian Government Department of Agriculture; see also glossary.

Because of developments in vaccine technology, changing international attitudes and the recent experiences of countries experiencing FMD outbreaks, Australia no longer views vaccination as a measure of last resort. Australia will consider the potential role of vaccination as part of the response strategy from the day an incursion of FMD is detected. Australia will prepare as though vaccination will be used in the event of an FMD incursion, to allow adequate preparatory measures to be put in place.

The role of vaccination in an FMD response will vary with a wide range of factors — for example, where and when the disease was introduced, the strain of virus, how long the disease might have been in Australia and its potential for spread. Therefore, Australia will maintain a flexible policy that allows decision makers to determine a role for vaccination that is appropriate for the specific outbreak scenario. Different vaccination strategies are possible (see Appendix 5 for details).

The CCEAD will provide the first meeting of the NMG with advice on the potential role of vaccination as a control strategy, based on what is known about the epidemiology of the outbreak at the time. The decision to vaccinate will probably need to be made in the absence of all desired information and should be regularly reviewed.

Australia has a contract for the supply of certain antigens through the Australian FMD Vaccine Bank under the FMD Production, Storage and Supply Agreement. This will provide vaccines to a number of FMD strains within 7 business days of notification. The antigens have been selected to provide broad coverage against potential FMD threats and will be regularly reviewed.

In the event of an FMD outbreak, the outbreak strain will be typed as a matter of urgency, to assess whether an appropriate antigen is held in the Australian FMD Vaccine Bank. If appropriate vaccine is available, the CCEAD will advise the NMG to order the constitution and delivery of the full supply of doses of appropriate vaccine, regardless of whether vaccination is included in the initial emergency response.

If the Australian FMD Vaccine Bank does not hold an appropriate antigen, or the number of doses of vaccine in the bank is considered insufficient, Animal Health Australia, under direction from the CCEAD and the NMG, will seek further supplies of vaccine from manufacturers and/or international vaccine stockpiles.

Australia does not have any FMD vaccines registered for routine use, but import and emergency use permits are in place. Importation of FMD vaccines requires an import permit from the Australian Government Department of Agriculture. Supply and use of the vaccine in Australia requires an emergency permit and consent to import from the Australian Pesticides and Veterinary Medicines Authority. Rapid deployment of FMD vaccines requires an early release certificate from the Australian Government Department of Agriculture. Importation, distribution, supply, use and disposal of a vaccine that is a genetically modified organism must also be licensed by the Office of the Gene Technology Regulator or permitted under an Emergency Dealing Determination by the minister responsible for gene technology. Full reconciliation will be required for all vaccines distributed.

A cold-chain distribution company has been contracted to clear the vaccine through customs, store vaccine at its cold store facility, distribute it as requested by Animal Health Australia and provide stock control. The company will also arrange for the return and destruction of unused vaccine doses.

An EAD Response Plan proposing the use of vaccination should discuss the objectives of vaccination, how vaccine is to be used strategically (including the species, location and other factors), biosecurity measures and the logistics of administration. Consideration should also be given to how vaccinated animals are to be managed after the outbreak (see below); identification and tracing of vaccinated animals; management of products from vaccinated animals; data management; and surveillance, resourcing, training and logistical requirements. Within an outbreak response, the vaccination strategy may vary for different at-risk populations.

The management of vaccinates — that is, whether they are to be removed from the population or allowed to live out their commercial lives — will be considered as part of the decision to use vaccine and during the response. Options may change in the face of changing market responses, surveillance capacity and stakeholder attitudes. A vaccinated animal management strategy (or strategies) will be agreed by the CCEAD, but may be reviewed depending on the nature of the outbreak. Appendix 5 outlines the framework for such a strategy. It may be feasible to retain some, or all, uninfected vaccinated animals after the eradication of FMD. Consideration of this option needs to take into account additional costs of surveillance to prove freedom, ongoing monitoring and available compensation mechanisms, and any effect on export markets. The trade implications of FMD vaccination in response to an outbreak are an evolving area in OIE guidelines, and Australia should ensure it maintains a close watching brief to inform its policy.

The match between the field and vaccine strains will need to be checked at regular intervals during an outbreak. However, the use of suppressive vaccination means that waning of vaccinate immunity (after 4–6 months) is unlikely to be a significant factor during the latter stages of an outbreak response. Six-monthly booster doses will be required if protection is required for longer than this.

Biosecurity practised by all field and vaccination teams is critical to the success of a vaccination program.

For further information on vaccination options and the decision criteria to be considered regarding vaccination, see Appendix 5. Operational details for the administration and application of a vaccination program are included in relevant nationally agreed standard operating procedures.[23]

3.2.6 Treatment of infected animals

Treatment is not appropriate for FMD under the Australian policy of eradication.

3.2.7 Treatment of animal products

A risk-based approach to the use of animal products and byproducts will be followed. Policies on the treatment of animal products may be modified during the response, as necessary.

The treatment, for further marketing, of most products and byproducts from IPs and DCPs is not permitted; this policy will also apply to products originating from animals and premises for a period of at least 14 days before the index case. These products must be

[23] www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/nasops

disposed of in accordance with the **Disposal Manual**. Marketing of products such as wool and embryos may be permitted under special conditions or after treatment, with their movement subject to permit. For further details on movement controls, see Section 4 and Appendix 1.

Products from SPs and TPs will be treated in the same manner as for IPs and DCPs while the SPs remain under suspicion or the trace has not been resolved; this will also apply to products produced during a minimum period of 14 days before the appearance of clinical signs on an SP. However, specified products, such as meat and hides, may be permitted to leave an SP for sale, subject to treatment under permit, or after an agreed period.

Section 4 describes recommended movement controls and appropriate permit conditions for meat, semen and embryos, offal, waste products and effluent, vehicles and equipment, wool, skins and hides, and stockfeeds.

Dairy products

Although people can occasionally develop mild infection by drinking infected milk, FMD is not considered a public health problem (Acha and Szyfres 1987). Therefore, the processing methods outlined below for inactivating FMDV in milk are primarily aimed at addressing the risk from milk that might be redirected for animal consumption.

Handling of milk from higher risk premises in the RA or CA

Milk must not be allowed to leave 'higher risk' premises (IPs, DCPs, SPs and TPs) and must be disposed of, or stored (in the case of SPs and TPs pending status confirmation), on farm. It may only be moved in two exceptional circumstances:

- where off-site disposal options are assessed as preferable (eg better environmental outcome, provided that they also lead to an equal or better disease control outcome)
- where capacity to manage on-farm disposal is exceeded (eg large number of TPs) and a suitable off-site disposal location and method have been identified.

In the circumstances described for these exceptions, milk from IPs, DCPs, SPs or TPs could be moved under permit to a designated disposal site within the RA or CA. Movement from the RA to the CA and from the CA to the RA would be allowed. Permit conditions must include appropriate biosecurity measures, including treatment to inactivate FMDV before the milk leaves the premises.

Handling of milk from lower risk premises in the RA and CA

Milk collected from 'lower risk' premises (at-risk premises and premises of relevance) may include some milk from subclinically infected cows that are incubating FMD. Milk from these premises should be processed in either the RA or the CA. All milk from, or combined with milk from, farms in the RA or CA must be processed to either Standard 1 (for human consumption or use) or Standard 2 (for animal consumption or use).

Raw milk and milk products from lower risk premises may be moved (for processing) between the RA and the CA (from the RA to the CA, and from the CA to the RA) under permit, subject to appropriate biosecurity measures applied to transport and processing facilities.

Movement for processing of raw milk and milk products from lower risk premises in the RA or the CA to the OA (the area outside the declared areas) will only be considered on a case-

by-case basis following a formal risk assessment process. Such movements would require approval by the CCEAD.

The treatments required for Standard 1 and Standard 2 processing are shown in Table 3.1. These are based on OIE and European Union guidelines.

Table 3.1 Standard 1 (minimum treatments for milk and other dairy products for human consumption or use, unless sourced from the outside area) and Standard 2 (minimum treatments for milk and other dairy products for animal consumption or use in FMD-susceptible animals, unless sourced from the outside area)

Type of processing	Standard 1	Standard 2
HTST processing	HTST processing of milk with a pH below 7	HTST processing applied twice
	HTST processing applied twice to milk with a pH equal to or above 7	
	HTST processing combined with another physical treatment — for example, maintaining pH 6 for at least 1 hour, additional heating to at least 72 °C combined with desiccation, or their equivalent	As for Standard 1
UHT processing	UHT processing (a minimum of 132 °C applied for at least 1 second) combined with another physical treatment — for example, maintaining pH 6 for at least 1 hour, additional heating to at least 72 °C combined with desiccation, or their equivalent	As for Standard 1
	A UHT process involving either: • direct heating at 143 °C for 2 seconds, or • indirect heating at 138 °C for 2 seconds	As for Standard 1
Other treatment	A manufacturing process that can be demonstrated to be equivalent to $F_0 3$[a]	As for Standard 1

HTST = high temperature – short time; UHT = ultra-high temperature
a Lethal effect on a microorganism equivalent to that obtained by heating for 3 minutes at 121.1 °C in a retort process

Bulk tanker movements of processed milk or milk products will require a general permit describing the load, origin and destination, and date of departure, to ensure that such product can be differentiated from raw milk.

[Conditions for the movement of unprocessed milk, processed milk and other milk products will be finalised in the Dairy Industry Enterprise Manual. Since these sections will be combined with the current text of the AUSVETPLAN FMD Disease Strategy Manual, they will be subject to a similar level of scrutiny (from AUSVETPLAN Technical Review Group, industry stakeholders and the Animal Health Committee) and clearance via the Agriculture Ministers' Forum.]

Milk and milk products from lower risk premises intended for human consumption or use and processed to Standard 1 must not be fed to FMD-susceptible animals nationally. An awareness campaign will be mounted about the risks of feeding such milk to susceptible animals.

3.2.8 Biosecurity for equipment and personnel

Increased biosecurity measures and standards must be immediately implemented by the relevant animal industries across Australia when an FMD outbreak is declared. These measures will be described in AUSVETPLAN enterprise manuals (several of which — Dairy Processing, Artificial Breeding Centres, Saleyards and Transport, and Wool Industry — are under development or revision, or close to finalisation). Routine movements of animals and animal commodities (eg milk), and associated service industries can be expected to be delayed in the initial stages of a response while biosecurity measures and permits are put in place.

All vehicles and drivers entering premises with susceptible animals will be required to comply with biosecurity protocols that treat the risk of transmission via fomites and potentially infected materials. Vehicle movements between farms should be kept to a minimum. Regular, routine vehicle movements onto farms, such as those for fodder deliveries and milk pick-ups, require particular attention due to the essential nature of these movements, their frequency and the risk that they may present.

To prevent spread of FMDV from farm to farm by milk tankers during an outbreak, raw milk and unpasteurised milk byproducts (whey) that may contain FMDV must be transported in a biosecure manner and must not be fed to susceptible animals. Biosecurity protocols for milk transport vehicles and drivers are needed to manage the risks presented by fomites and milk samples. Only modern milk tankers of design specified in the AUSVETPLAN **Dairy Processing Enterprise Manual** (under development) should be used in the RA and the CA to prevent aerosols, spillages and leakage.

3.2.9 Disposal of animals and animal products

The method chosen for disposal will require consideration of the risks to the environment and the risk of spreading the disease (see the **Disposal Manual**).

The preferred method for disposal of carcasses, manure, animal products (including milk) and feedstuffs depends on the material to be disposed of, the resources available and the local environment. Topography, prevailing weather and environmental agency requirements (fire, environment, conservation and heritage) may limit disposal options.

Disposal must be done in a way that prevents feral animals gaining access to contaminated material. Under certain circumstances, methods other than burial (such as composting or rendering) will be considered. On-site disposal requires decontamination of heavy machinery.

On-site or off-site disposal of any carcasses, animal products or other potentially contaminated material must be in accordance with Section 4, and auditable in terms of biosecurity, traceability and financial requirements.

Swill feeding and feeding of dairy products to FMD-susceptible livestock

Swill feeding of pigs and feeding of milk, milk products, waste, surplus and out-of-date retail milk, and washings from processing plants carries a high risk of introducing FMD to a herd. A multi-agency approach will be needed to enforce current swill-feeding bans and swiftly introduce legislation, if not already in place, to ban feeding of dairy products to pigs and other FMD-susceptible species (unless the products have been treated as described in Section 3.2.7 or are to be fed to the offspring of dairy animals resident on the same farm). Security at municipal garbage tips should be improved to prevent feral pigs gaining access

to domestic food scraps. A widespread, multilingual public awareness campaign should support these controls.

Disposal of milk on higher risk premises

Milk will not be collected for commercial processing from IPs, DCPs, SPs and TPs but will be subject to sanitary disposal. On-farm storage may be considered for SPs and TPs pending confirmation of their status if it is likely that the status will be resolved within food safety timelines and capacity is available.

This is likely to result in large volumes of milk requiring on-farm (or off-farm) disposal. The amount of milk for disposal will depend on the time of year, and the location and size of the outbreak. Options such as drying off cows and using bobby calves already on the farm may be considered to reduce the amount of milk that ultimately requires disposal.

Disposal of milk will be a major challenge during an FMD outbreak involving a dairying area. All animals on IPs and DCPs should be culled quickly, so the volumes of milk requiring disposal on these premises should be limited. The relative surveillance priority of dairy farms that are SPs and TPs must be assessed, since milk volumes may accumulate over time.

Possible methods of milk disposal are described below. For more information, see the **Disposal Manual**.

Spraying onto pastures after inactivation of FMDV

Milk is treated on farm to inactivate FMDV — for example, with citric acid[24] — and then diluted and sprayed onto pastures. On-farm disposal of milk is only viable for short periods (a few days); it would therefore need to be used in conjunction with rapid drying off or destruction of cattle (eg on IPs).

Milk must not be permitted to run off the property, and odour could be a concern.

Use of this method would require approval from the local or regional environment protection authority at the time of the outbreak.

Composting

A few milk processing plants may already use composting for disposal of at least part of their dairy waste. Composting is limited by the high fat content of milk, which may reduce its effectiveness, result in odour and produce potentially phytotoxic compost; and the high moisture content and large volumes of milk, which lead to problems with transport, storage, mixing with co-composting materials and control of leachate. The use of composting could be improved by first reducing the moisture content of dairy wastes, by water extraction or conversion to powder, for storage and subsequent composting.

Burial

Milk can be buried in trenches and other carcass disposal pits, given that livestock on IPs and possibly DCPs will be culled and require disposal. Concerns about contamination of

[24] Ensuring that a pH of less than 6 is achieved and maintained for an appropriate period

groundwater are more likely than for spraying onto pasture, and there may be difficulties with sealing a pit that contains both carcasses and milk.

Commercial waste disposal (landfill or composting)

Use of landfill sites for disposal is limited by the high volume and moisture content of milk. The feasibility of this method could be improved by first reducing the moisture content of dairy wastes, by water extraction, or conversion to powder, for storage and subsequent burial or composting.

Before milk can be disposed of in commercial landfill or composting facilities, the outcome of treatment of the milk must be known, to ensure that FMDV is inactivated (preferably, milk would be treated before it is collected). This option may be limited by cost and the capacity of commercial operations.

Collection and processing of milk into milk powder for storage and subsequent disposal

Use of this method is limited because processing plants for spray drying seldom have spare capacity. Commercial plants processing milk from low-risk premises, for sale, must not accept milk from higher risk premises unless contracted. A milk powder plant that is not operating at the time (due to loss of export markets) could be contracted solely to process milk from higher risk premises for subsequent disposal of the powder by landfill/burial or incineration. Memoranda of understanding may be considered for this purpose.

Use of central effluent wastewater disposal sites

The use of larger central sites where milk can be stored, treated and disposed of safely — for example, a retired water authority sewage treatment facility — should be considered. However, such a site may not be available during an FMD outbreak. Milk would be treated to inactivate virus before disposal.

Tallow recyclers

Use of tallow recyclers is limited as they will only accept high-quality fats.

Effluent ponds on farm

Use of effluent ponds for disposal raises problems due to the high biological oxygen demand of milk. However, it may be possible where milk can be effectively and rapidly diluted. Remedial treatments to restore aerobic decomposition may be required.

3.2.10 Decontamination

Animal products (such as hides and wool), equipment, materials and buildings that may be contaminated will be thoroughly decontaminated.

The surfaces of roads and yards adjacent to and within IPs and DCPs will be subject to appropriate decontamination procedures. If decontamination cannot be achieved effectively and quickly, contaminated materials, equipment and infrastructure will be destroyed. At all stages, steps will be taken to prevent the generation and dispersal of infective dusts and aerosols.

Agents that destroy FMDV include sunlight (by desiccation, not by the effects of ultraviolet radiation), and acid and alkaline disinfectants such as sodium hydroxide and sodium carbonate (washing soda). It is preferable to use disinfectants with label claims of effectiveness against FMDV or similar viruses.

See the **Decontamination Manual** for further details.

3.2.11 Sentinel animals and restocking

Sentinel animals

A program for the placement of sentinel animals on former IPs and DCPs, to resolve their status, will be determined by the local control centre. The program must be epidemiologically robust enough to detect disease on the premises should it still be present. It can only begin after decontamination is complete. Animals on the premises should be monitored for clinical signs of infection, and/or laboratory testing should be conducted, to resolve the premises status.

Restocking

Once a premises has been resolved, restocking will be conditional on CVO approval (for example, subject to receipt of seronegative test results) and would normally be done on an area basis rather than a premises basis.

3.2.12 Control measures at processing plants that have received raw milk from premises that subsequently become infected premises

When a farm is declared an IP or DCP, the following measures must be implemented:

- Raw milk in the farm vat will be disposed of in accordance with Section 3.2.9, and no further milk collections will occur.
- A tanker with raw milk that is en route from the IP or DCP to the processing plant must be directed to observe specified biosecurity measures (eg decontamination) and proceed without further pickups to
  - a processing plant, if the company is willing to process the milk in accordance with Standards 1 or 2 (see Section 3.2.7), or
  - a disposal site nominated by the disease control authority, or
  - return to the IP or DCP.
- Processing plants in the RA must comply with increased biosecurity protocols to continue receiving milk from any area, and be approved as an approved processing facility (APF[25]). Facilities receiving milk from the RA and CA must also be approved as an APF.
- To be approved as an APF, the plant must demonstrate that
  - milk is processed to Standard 1 for human consumption only or to Standard 2 for products for animal consumption
  - vehicles are decontaminated on entry and departure from the plant
  - tankers have real-time traceability
  - biosecurity protocols are implemented for on-farm procedures, including collection of milk samples and transfer of bulk milk to the tanker

[25] An abattoir, knackery, milk processing plant, or other such facility to which animals or animal products have been introduced from lower risk premises under a permit for processing to an approved standard

  - biosecurity measures are implemented and maintained on the plant.
- If raw milk from the IP or DCP has arrived at the processing plant and been unloaded into silos from the day of detection of FMD to a minimum of 14 days before the date of onset of the first suspected case on the farm, the plant becomes a dangerous contact processing facility (DCPF) (see Section 4.1.2), until a risk assessment has been conducted and appropriate decontamination and biosecurity measures have been implemented.
- If appropriate increased biosecurity measures have already been put in place before the receipt of the farm's milk (and at least 14 days before detection of FMD if the farm is already supplying the processor), the processor is an APF and no change in status is required while it remains compliant with APF requirements.

When a processing plant is declared a DCPF, the following measures must be implemented:

- All milk on hand and subsequently received will be processed in accordance with Standards 1 or 2 (see Section 3.2.7).
- The processing plant will implement and maintain increased biosecurity measures, such as
  - increased frequency of decontamination using methods that will inactivate FMDV associated with dairy products
  - procedures to ensure separation of 'raw milk' and 'clean' areas; these procedures will be specified in the AUSVETPLAN **Dairy Processing Enterprise Manual** (under development) and will allow continued operation during the response.
- Milk and other dairy products will be traced (see Section 3.2.3) to the date of declaration to establish any potential consumption by animals.
- If the processor wishes to continue to receive milk from the RA or CA, it will be required to comply with and maintain the APF increased biosecurity measures and will be designated as an APF (after going through the resolving process and being designated as a resolved premises (RP)).
- If the processor chooses never to receive RA and/or CA milk, or to receive such milk after completion of decontamination, the facility would be designated as a zero susceptible stock premises (ZP) (after going through the resolving process and being designated as an RP).

3.2.13 Wild animal, feral animal and vector control

Experience with FMD in tropical countries suggests that spread from cattle and buffalo to pigs during casual contact is rare. However, if a feral pig became infected through eating an infected carcass, the virus could spread in the feral pig population. The amount of subsequent spread will depend on local factors, including feral pig densities and population contiguity.

Entry, spread and maintenance of FMD in feral animal populations will be subject to ongoing risk assessment to ensure that feral animals are fully considered in the design of the eradication program. Risk mitigation programs will be implemented in feral animal populations that are assessed to pose an unacceptable risk. Assessment will require information about:

- density and distribution of the animals
- social organisation, including home ranges

- habitat
- perceived contact with domestic species
- strain of FMDV
- length of time feral animals could have been exposed to the virus
- potential exposure of feral animals to risk materials, such as at landfill sites, in paddocks on which milk has been sprayed, or in areas used for composting.

This information will help to determine the level of measures to be applied, including:

- containment
- tracing and surveillance
- population reduction
- restrictions on hunters.

Although they rarely act as mechanical vectors, rodents that are likely to be dispersed from buildings, silos or other structures during operations on premises within the RA should be exterminated before decontamination begins.

See the **Wild Animal Response Strategy** for further details.

3.2.14 Public awareness and media

The media campaign will emphasise the importance of farmers inspecting susceptible animals regularly, and reporting suspicious lesions and unusual deaths promptly. The importance of not feeding swill and dairy products that have not been processed to the standard required for animal feeds will be emphasised, as will the need to avoid contact between domestic animals and feral pigs. The importance of movement controls and their meaning to individuals will also be highlighted.

Animal welfare is an important consideration for animal health authorities and the public during an EAD outbreak. This will especially be the case if imposed movement controls hinder the orderly slaughter of animals at abattoirs, or if large numbers of livestock and feral animals are targeted for destruction. Communication strategies will take into account social reactions to the destruction of livestock during the emergency response.

Vaccination is an important subject to be managed by public relations officers. If vaccination is to be used, key messages (for example, that vaccine is being used to support stamping out, and that vaccinated animals are safe for human consumption) should be relayed early.

The use of social media and other such mechanisms will be an integral part of these efforts, to ensure wide distribution of important messages.

For further details, see the **Public Relations Manual**.

3.2.15 Public health implications

Although FMD has no significant public health implications with regard to infection, an outbreak in Australia will have a devastating impact on affected livestock owners, rural workers and communities. Serious social stresses and impacts will be associated with an outbreak of FMD.

3.2.16 Stand down

The CCEAD will determine when the outbreak has been controlled or eradicated and will advise the NMG. The NMG will determine when the national FMD control measures can be wound down or ceased, and each jurisdiction will advise its ministers of this decision. The NMG will also advise the High Level FMD Management and Recovery Group (HLFMRG) of this decision. Relief and recovery activity will need to continue after disease control and eradication operations have wound down, and the HLFMRG will determine the timing of the stand-down for national relief and recovery. Further information is provided in the COAG MoU regarding a national coordination framework for responding to an outbreak of FMD.[26]

3.3 Funding and compensation

FMD is classified as a Category 2 EAD under the EAD Response Agreement between the governments of Australia and the livestock industries.

Category 2 diseases are EADs that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the affected livestock industries. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).[27]

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

[26] www.coag.gov.au/node/50

[27] Information about the EAD Response Agreement can be found at www.animalhealthaustralia.com.au/programs/emergency-animal-disease-preparedness/ead-response-agreement

4 Recommended quarantine and movement controls

4.1 Guidelines for classifying declared areas

4.1.1 National livestock standstill

Following a diagnosis of foot-and-mouth disease (FMD) or a strong suspicion of FMD, a national livestock standstill will be imposed, leading to total movement controls on all species susceptible to FMD. The standstill will be triggered by the National Management Group (NMG), acting on the advice of the Consultative Committee on Emergency Animal Diseases (CCEAD) and will be implemented for at least 72 hours. Easing, lifting or extending the standstill will be based on a risk assessment and the developing knowledge of the epidemiology of the outbreak.

The national livestock standstill will apply only to FMD-susceptible animals. However, during the livestock standstill, jurisdictions may impose movement controls over other products (including meat, carcases and/or offal) and equipment (see also Section 3.2.2).

4.1.2 Premises classifications

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

For the purposes of this manual, 'high-risk premises' are infected premises, dangerous contact premises, dangerous contact processing facilities, suspect premises and trace premises.

Infected premises (IP)

An IP is a premises on which animals meeting the FMD case definition (see Section 1.4.4) exist, or the causative agent of FMD exists, or there is a reasonable suspicion that either exists.

Dangerous contact premises (DCP)

A DCP is a premises that, based on a risk assessment, is considered highly likely to contain an FMD-infected animal(s) or contaminated animal products, wastes or things. For FMD, the restricted area (RA) would be drawn around DCPs. The risk assessment would consider factors such as the stage of the response, the epidemiology of FMD, the animal(s) present and the local situation. Although the susceptible animal(s) on such premises are not showing clinical signs, they are considered to have been significantly exposed to FMD virus (FMDV) — this might be via an FMD-infected animal(s) or contaminated animal products, wastes or things.

Since a DCP presents an unacceptable risk to the response if the risk is not addressed, such premises are a high priority for investigation and action. An investigation of a DCP may produce the following outcomes:

- If the presence of an FMD-infected animal or contaminated animal products, wastes or things is confirmed, the premises would be designated as an IP.
- If their presence is not confirmed but the likelihood is considered to remain high, the premises would continue to be designated as a DCP.
- If, over the course of the response, it is considered unlikely that an FMD-infected animal or contaminated animal products, wastes or things are present, the premises would receive the qualifier assessed negative (AN), and would be designated as an at-risk premises (ARP).

Dangerous contact processing facility (DCPF)

A DCPF is an abattoir, knackery, wool store or milk processing plant (or other such plant) to which it appears highly likely that FMD-infected animals, or contaminated animal products, wastes or equipment have been introduced. This designation provides authorities with power over such premises to facilitate product tracking, and serves as a communication tool for reporting nationally and internationally on progress in the response.

Approved processing facility (APF)

An APF is an abattoir, knackery or milk processing plant (or other such facility) to which animals or animal products have been introduced from lower risk premises under a permit for processing to an approved standard. The facility maintains increased biosecurity standards.

Suspect premises (SP)

SP is a temporary designation applied to premises that contain a susceptible animal(s) not known to have been exposed to FMDV but showing clinical signs that require investigation. The RA should contain as many SPs as practical. The investigation may produce the following outcomes:

- If the case definition is confirmed, the premises would be designated as an IP.
- If the case definition is not confirmed but suspicion remains, the premises would continue to be designated as an SP.
- If the case definition is ruled out, the premises would receive the qualifier AN. However, if it is located in the RA, it would be designated as an ARP. If it is located in the control area (CA), it would be designated as a premises of relevance (POR).

Trace premises (TP)

TP is a temporary designation applied to premises that contain a susceptible animal(s) that tracing indicates may have been exposed to an FMD-infected animal(s) or contaminated animal products, wastes or things, and that requires investigation. Exposure may be via aerosol, especially if the premises is contiguous with an IP, or via fomites. The investigation may produce the following outcomes:

- If the case definition is met, the premises would be designated as an IP.
- If it appears highly likely, as a result of an epidemiological assessment of the risk that the disease is present in the specific epidemiological situation, that the TP contains an

infected animal(s) or contaminated animal products, wastes or things, it would be designated as a DCP.

- If the trace proves to be insignificant, the premises would receive the qualifier AN. However, if it is located in the RA, it would be designated as an ARP. If it is located in the CA, it would be designated as a POR.

At-risk premises (ARP)

An ARP is a premises in an RA that contains a susceptible animal(s) but is considered at the time of designation not to be an IP, DCP, SP or TP. The animal(s) on such premises are subject to procedures such as heightened surveillance and movement restrictions. This designation provides authorities with power over such premises, facilitates tracking and serves as a communication tool for reporting nationally and internationally on progress in the response.

Premises of relevance (POR)

A POR is a premises in a CA that contains a susceptible animal(s) but is considered at the time of designation not to be an SP or TP. The animal(s) on such premises are subject to procedures such as heightened surveillance and movement restrictions that are applicable in the CA.

Resolved premises (RP)

An RP is an IP, DCP or DCPF that has completed the required control measures and is subject to the procedures and restrictions appropriate to the area in which it is located.

Unknown status premises (UP)

A UP is a premises that has been identified as having an unknown animal status.

Zero susceptible stock premises (ZP)

A ZP is a premises that contains no FMD-susceptible animals.

4.1.3 Declared areas

In the declaration of areas, the following factors should be taken into account:

- industries involved
- environmental features
- movement patterns of susceptible species
- processing options (livestock and products)
- natural and artificial barriers and easily recognisable boundaries
- other geographic features such as road networks and towns
- nature of the outbreak
- livestock species involved
- feral animal involvement.

Overseas experience (eg in the United Kingdom in 2001, Japan in 2010 and South Korea in 2010–11) suggests that an initially conservative approach in defining declared areas

(ie overstating rather than understating their size) is important, to include as many unknown disease-spreading movements as possible.

Restricted area (RA)

An RA will be a relatively small declared area (compared with a CA) around IPs and DCPs, including as many SPs and TPs as practicable, that is subject to intense surveillance and movement controls. Movement out of the area will be prohibited except under strict permit conditions (see Section 4.4). Multiple RAs may exist within one CA.

In the case of FMD, an initial RA of at least a 3-kilometre radius will be drawn around all IPs and DCPs, including as many SPs and TPs as practicable. The boundaries will be modified as new information comes to hand. The actual distance in any one direction will be determined by factors such as terrain, roads, the pattern of livestock movements, livestock concentrations, the weather (including prevailing winds), the distribution and movements of susceptible feral animals, and known characteristics of the virus serotype. A high level of movement control and surveillance will apply. Although it would be convenient to declare the RA on the basis of local government areas, this may not be possible, as such areas are likely to be large and difficult to manage.

Control area (CA)

The purpose of the CA is to control movement of susceptible livestock and livestock products for as long as is necessary to complete tracing and epidemiological studies.

The CA will be a larger declared area around the RA(s) — initially, possibly as large as the state or territory in which the outbreak occurs — where restrictions will reduce the risk of disease spreading from the RA. The CA will have a minimum radius of 10 kilometres, encompassing the RA (see also Section 3.2.2). It may be defined according to geography, climate and the distribution of feral animals. The boundary will be adjusted as confidence about the extent of the outbreak increases.

The World Organisation for Animal Health (OIE) Terrestrial Code standards on FMD surveillance (Articles 8.5.42 to 8.5.48) and zoning (Chapter 4.3) give guidance on specific activities. RAs and CAs are declared for the purposes of disease control, and zones may be used for trade and business continuity purposes. RAs and CAs declared for the purpose of disease control may not be the same as OIE zones for trade. For the latter, consideration will need to be given to the Terrestrial Code guidelines. In general, surveillance and movement controls will be less intense in the CA than in the RA, and FMD-susceptible animals and their products may be permitted to move under permit within and from the CA.

Outside area (OA)

The OA is not a declared area but is used to describe the rest of Australia outside the declared areas. The OA will be subject to surveillance. As it is highly desirable to maintain the OA as 'disease free', the movement of animals and commodities from the RA and CA into the OA will be restricted.

4.2 Guidelines for issuing permits

When assessing risk for the purposes of issuing a permit, the elements to consider may include:

- sources of risk
  - species of animal
  - type of product
  - virus presence on both the originating and destination premises
  - organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
  - proposed use of the animals or product
  - proposed transport route
  - vaccination status of the animals
  - biosecurity of transport
  - biosecurity and monitoring at the destination
  - environment and natural events
  - community and human behaviour
  - risk of sabotage
  - regulations and standards
  - available resources for compliance and enforcement
- nature of impact
  - livestock health (health of affected species, including animal welfare)
  - human health (including occupational health and safety)
  - trade and economic impacts (including commercial and legal impacts)
  - environmental impacts
  - organisational capacity
  - political impacts
  - reputation and image
- proposed risk treatment measures
  - vaccination
  - processing of product
  - disinfection or other treatment of animals, vehicles and fomites
  - security
  - communication.

4.3 Types of permit

Permits are either general or special. They are legal documents that describe the animal(s), commodities or things to be moved, the origin and destination, and the conditions to be met for the movement. Either type of permit may include conditions. Once permit conditions have been agreed from an operational perspective, all permit conditions must be met for every permit. Both general and special permits may be in addition to documents required

for routine movements between or within jurisdictions (eg health certificates, waybills, consignment notes, National Vendor Declarations (NVDs)).

4.3.1 General permit

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

4.3.2 Special permit

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

Emergency permit

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

4.4 Recommended movement controls for FMD

The principles for the recommended movement controls (Sections 4.4.1 to 4.4.13) are as follows:

- Containment and eradication of FMD is the highest priority. Therefore, 'normal business movements' are not allowed.
- Live animals pose the greatest risk of disease spread; therefore, their movements from all premises within the RA and CA must be strictly controlled.
- The OA should remain as 'clean' as possible. Therefore, movement of animals from the RA to the OA is prohibited, and movement of products is generally prohibited. Movement of animals and products from the CA to the OA will also be restricted.
- TPs and SPs are temporary classifications, and every effort should be made to resolve the status of these premises as soon as possible.
- The numbers of susceptible animals within the RA should be minimised. Therefore, movements of animals into the RA will be limited and usually for slaughter only.
- Movement restrictions are more stringent within the RA than within the CA, and will be more stringent in the early stages of the response.

- Movement controls may be varied during a response from those listed here. However, this will involve a variation to the agreed Emergency Animal Disease Response Plan, with endorsement by the CCEAD and the NMG.
- Recommended movement controls apply to any movement off a premises, whether on foot or by vehicle, that involves either public or private land.

4.4.1 Recommended movement controls for live susceptible animals

A four-stage approach to movement controls for live susceptible animals will be implemented. The first two stages will apply when the national livestock standstill is in place. Stage 1 applies at the time of the declaration of the livestock standstill and applies to animals in transit. Stage 2 applies to new movements while the livestock standstill is in force. These first two stages are not necessarily consecutive and may occur at the same time. The third stage (stage 3) will be after RAs and CAs have been set up and the standstill has been revoked, but the outbreak is considered by the CCEAD to be not yet under control. The fourth stage (stage 4) will occur when the authorities are confident that the outbreak has been stabilised, and the CCEAD considers it to be under control. Stages 3 and 4 may apply to different areas at the same time. For example, an outbreak may be under control in one affected jurisdiction but not another.

Stage 1: Live susceptible animals in transit at the time of declaration of the livestock standstill

The nationally agreed standard operating procedure (NASOP) for management of livestock in transit at the time a livestock standstill is declared for FMD provides detailed guidance on movements permitted during a standstill. It is available on the website of Animal Health Australia.[28] Live susceptible animals undergoing a journey at the time of the declaration of the livestock standstill should be managed in accordance with this NASOP.

A media campaign will be conducted when a livestock standstill is declared, which will advise people who are in charge of live susceptible animals in transit of the content of the NASOP and to follow these directions. People who cannot meet the conditions in the NASOP should contact their local animal health authorities for directions concerning ongoing movement.

Stage 2: Movement of live susceptible animals while the livestock standstill is in force

While a standstill remains in force, the movement of live susceptible animals is prohibited except under an emergency permit. A permit will be issued only in exceptional circumstances. Before an emergency permit is issued, a risk assessment should be done, including an assessment to ensure that the biosecurity standards at the receiving premises are appropriate and that there are no links to the premises that initiated the standstill.

Emergency permit conditions for the movement of live susceptible animals during the standstill will include specifying:

- the approved route to be taken
- single consignment per load

[28] www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Management-of-livestock-in-transit-at-the-time-a-national-standstill-is-declared.pdf

- appropriate decontamination of equipment and vehicles before and after movement
- absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel
- absence of links to the premises that initiated the standstill
- physical identification of animals (eg National Livestock Identification System — NLIS, or other ear tag, brand) with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

Stage 3: Movement of live susceptible animals within and between areas after RAs and CAs have been set up and the livestock standstill has been lifted, but the outbreak is not yet considered to be under control

Due to the risk of transmitting FMD, the movement of live susceptible animals from high-risk premises is generally prohibited. The movement of live susceptible animals into an RA should be minimised, and usually only for slaughter, to limit the number of susceptible animals within the RA.

See Appendix 1 for more details on the recommended movements of live susceptible animals between declared areas during stage 3.

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

The risk of FMD transmission due to the movement of live animals remains high, but, based on the effectiveness of the control measures in stage 3, some movement restrictions may be reduced.

See Appendix 1 for more details on the recommended movements of live susceptible animals between declared areas during stage 4.

4.4.2 Recommended movement controls for semen and embryos from susceptible animals

FMD can be transmitted by semen and untreated embryos; therefore, movement of semen from high-risk premises and out of the RA should be prohibited. To enable business continuity, some movements of semen sourced from properties in the CA and OA will be allowed into the RA and CA under permit. Semen and embryos collected more than 28 days before the estimated time of introduction of the disease is confirmed will be allowed to be moved within and between declared areas and into the OA under a general permit (GPd; see Table A1.3) and will not need to be destroyed. Such movements will require supporting records — that is, evidence of an operational biosecurity manual, including maintenance of biosecurity procedures, accurate record keeping, permanent identification of semen/embryo straws and vials, evidence of adequate disinfection of semen/embryo containers and equipment on leaving the artificial insemination centre and after use on a farm, and certification that the semen or embryos have been stored only with germplasm of equivalent FMD health status and that fresh liquid nitrogen has been used. The semen and embryos that meet these requirements can be used under normal jurisdictional arrangements. However, semen and embryos on IPs and DCPs, no matter when or where they were collected, may need to be destroyed as part of the resolution of the premises.

Although the OIE Terrestrial Code and the International Embryo Transfer Society (IETS) have concluded that the risk of FMD transmission by bovine embryos is negligible (provided that they have been processed according to the standards in the IETS manual),

further studies are required before conclusions can be made about the risk of FMD transmission via sheep, goat and pig embryos.

Semen and embryos being transported by the supplying company at the time of declaration of the livestock standstill should be returned to the sender, if practical. If this is not practical, the container may proceed to its destination, subject to local entry requirements applying under the emergency animal disease situation. Deliveries by a courier or post should also proceed to their destination, subject to local entry requirements under the emergency animal disease situation. For any of these deliveries, containers must not be opened. Delivery must be notified to state or territory animal health authorities, who should record the semen or embryo delivery and decide whether appropriate disposal of the container and contents is required.

Pathogens may persist in low-temperature environments, including in liquid nitrogen tanks, for prolonged periods. Disinfection of tanks or containers before and after transport is therefore important.

See the **Artificial Breeding Centres Manual** for more information on operation of artificial breeding centres during an emergency animal disease event.

See Appendix 1 for more details on the recommended movements of semen and embryos.

4.4.3 Recommended movement controls for meat, carcases and offal of susceptible animals

Meat, carcases and offal from susceptible animals or contaminated materials from low-risk premises do not present a significant risk of FMD transmission unless fed to susceptible animals; therefore, movement of these products would generally be allowed from registered abattoirs. Where FMD-free zones are implemented for trade purposes, restrictions may still be applied on these products.

Increased awareness of swill-feeding prohibitions should be part of the media campaign.

No meat, meat products or carcases of susceptible animals, including field-shot animals, from premises that are not registered abattoirs or commercial meat processing enterprises should be moved within or out of either the RA or the CA.

See Appendix 1 for more details on the recommended movements of meat and carcases.

4.4.4 Recommended movement controls for carcasses of animals culled for disease control purposes

There may be circumstances under which carcasses of animals culled for disease control purposes cannot be disposed of on-site and need to be transported either within the RA or to a more suitable disposal site outside the RA. Movements of such carcasses should be in accordance with NASOP 03: Loading and unloading of carcasses and materials for biosecure transport (version 1.1)[29] and NASOP 27: Biosecure movement of infected carcasses and

[29] www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Loading-and-unloading-of-carcasses-and-materials-for-biosecure-transport.pdf

materials during road transport (version 1.0).[30] These situations should be considered on a case-by-case basis, and the movement permit should include the following conditions:

- Carcasses for disposal are transported to a declared ZP or disposal site in a biosecure manner (ie in such a manner that prevents leakage of materials from the transport vehicle).
- Transport is by an approved route.
- Carcasses are not brought into direct or indirect contact with susceptible species.
- After transportation, vehicles are decontaminated appropriately and in accordance with the **Decontamination Manual**.

4.4.5 Recommended movement controls for effluent from susceptible animals

Effluent needs to be appropriately managed to minimise the risk of exposing susceptible animals to contamination (see the **Decontamination Manual**).

Because effluent (eg manure, yard washings and other such waste) can transmit FMD, it should preferably be disposed of on-site. If movement of effluent from high-risk premises is required, it should only be to premises without animals. Once potentially contaminated effluent is accepted by a site, that site will be designated as a DCP; therefore, careful consideration should be given to the disposal site and the need to limit access of susceptible species to that site for an appropriate period.

The **Decontamination Manual** provides specific details of procedures to reduce the infectivity of effluent, and the **Disposal Manual** provides details on composting and other disposal options.

See Appendix 1 for more details on the recommended movements of effluent.

4.4.6 Recommended movement controls for animal byproducts

Animal byproducts include skins, hides, horns, hoofs and knackery products, which may need to be transported off-site (from DCPFs or high-risk premises) for disposal. This material should not be transported outside the RA or the CA in which the establishment is located. If movement of byproducts from high-risk premises is required, it should only be to premises without animals.

The following permit conditions apply to movements to a biosecure disposal or rendering facility:

- Animal byproducts are transported in a biosecure manner (i.e. in such a manner that prevents leakage of materials from the transport vehicle).
- Transport is by an approved route.
- The material is not brought into direct or indirect contact with susceptible species.
- After transportation, vehicles are decontaminated appropriately and in accordance with the **Decontamination Manual**.

[30] www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Biosecure-transport-of-contaminated-carcsses-and-material-during-road-transport.pdf

Once potentially infected byproducts are accepted by a site, that site will be designated as a DCP; therefore, careful consideration should be given to the disposal site and the need to limit access of susceptible species to that site for an appropriate period.

Animal byproducts from higher risk premises that are destined for use, not disposal (eg hides, skins), must be appropriately decontaminated to inactivate FMDV.

4.4.7 Recommended movement controls for empty livestock transport vehicles and associated equipment

Because the survival time of FMDV in organic matter may be weeks to months, vehicles that have been used to transport live susceptible animals and equipment used with live susceptible animals or their products must be thoroughly cleaned[31] after use. The following guidelines apply to other vehicles and equipment, such as mining trucks, feed trucks, utilities vehicles and wind farm vehicles, that enter premises within the declared areas.

For movements within RAs and CAs of vehicles and equipment that have had direct contact with susceptible animals, and their products and wastes, and movements of these vehicles and equipment from RAs to CAs or OAs, an SpP with the following conditions should be obtained:

- The vehicles and equipment are appropriately decontaminated before and after use at an appropriate site (eg truck wash-down facility at an abattoir). It should be ensured that vehicles and equipment have adequate contact time with the relevant disinfectant before use (refer to the **Decontamination Manual** for disinfectant information and appropriate contact times).
- On leaving higher risk premises or the RA, all vehicles will be subject to inspection and/or appropriate decontamination.

For movements within CAs of vehicles and equipment that have had direct contact with susceptible animals or their products, and movements of these vehicles and equipment from CAs to OAs, a GP should be obtained with the following conditions:

- The vehicles and equipment must be appropriately decontaminated before and after use at an appropriate site (eg truck wash-down facility at an abattoir). It should be ensured that vehicles and equipment have adequate contact time with the relevant disinfectant before use (refer to the **Decontamination Manual** for disinfectant information and appropriate contact times).

Decontamination sites for vehicles should have sufficient equipment, water supply, drainage and materials to decontaminate the expected number of vehicles. Further information on decontamination procedures and site preparation is available in the **Decontamination Manual** and NASOP 12: Decontamination of large equipment (version 1.0).[32]

4.4.8 Recommended movement controls for milk and milk products

[Drafts are yet to be finalised.]

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[31] Refer to the **Decontamination Manual** for more information on cleaning and decontamination procedures.

[32] www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Decontamination-of-large-equipment.pdf

4.4.9 Recommended movement controls for wool and other fibre

Wool and other fibre will only be permitted to leave premises in the RA and CA to go to a premises where there are no susceptible animals under one of the following conditions:

- disinfection of the outside of the wool bales with an appropriate treatment at the site of origin, and storage of the bales for an appropriate time and at an appropriate temperature at the second site; or
- storage for an appropriate time and at an appropriate temperature that ensures inactivation of FMDV.

Wool bales moved to other sites within a minimum of 14 days before the original premises are designated as an IP require disinfection of the outside of the wool bales. The bales must be stored for an appropriate time and at an appropriate temperature at the second site.

Movement will be subject to permit after verification of the correct treatment/storage.

4.4.10 Recommended movement controls for people and nonsusceptible animals

Movement of people and nonsusceptible animals off IPs, DCPs, SPs and TPs will be restricted and subject to appropriate decontamination procedures to prevent mechanical spread of FMDV. Within the RA, people who regularly travel from farm to farm and come into contact with susceptible animals will be required to undergo appropriate decontamination of themselves, and their outer wear, equipment and vehicles between properties, and keep detailed records of their movements. Unnecessary movements of people and nonsusceptible animals onto and off premises with susceptible animals in RAs should be discouraged.

Within the CA, movements will not be restricted.

Further information is available in NASOP 01: Personal decontamination — entry and exit procedures (version 1.1)[33] and NASOP 26: Decontamination of groups of people — entry and exit procedures (version 1.0).[34]

4.4.11 Recommended movement controls for crops, grains, hay, silage and mixed feeds

Crops, grains, hay and silage harvested from paddocks that were sprayed or treated with effluent on an IP or DCP within the 14 days before the first signs of FMD, or mixed feeds made from such constituents, are not permitted to be moved off-site until the premises is declared free from FMD and appropriate decontamination has occurred. Other crops and grains may be removed from IPs and DCPs after the completion of decontamination of the material[35] and moved to other premises in either the RA or the CA, provided that the vehicle movement requirements are observed. Crops and grains may be moved from lower risk premises within the RA or CA to other premises in either the RA or the CA, provided that the vehicle movement requirements are observed.

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33 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Personal-decontamination-entry-and-exit-procedure.pdf

34 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Decontamination-of-groups-of-people-entry-and-exit-procedures.pdf

35 Refer to the **Decontamination Manual** for more information on cleaning and decontamination procedures.

Movements of feeds onto IPs and DCPs may be necessary for animal welfare reasons; these would be permitted from low-risk premises or premises in the OA, provided that the vehicle movement requirements are observed.

4.4.12 Sales, shows and other events

All sales, shows and other events involving live susceptible animals within the RA are prohibited.

Events such as sales and shows in the CA and OA may proceed during stage 4 at the discretion of the relevant jurisdictional CVO, unless the risk associated with such events is deemed unacceptable within the response.

People movements for such sales, shows and events should be in accordance with Section 4.4.10.

4.4.13 Stock routes, rights of way

Stock routes and rights of way in the RA should be closed for the duration of the response. Stock routes and rights of way in the CA and OA may be opened at the discretion of the relevant jurisdictional CVO unless the risk associated with such events is deemed unacceptable within the response.

4.5 Guidelines for reclassifying previously declared areas (RAs and CAs)

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

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

The key principles for reclassifying a previously declared area are as follows:

- The area is epidemiologically distinct from other declared areas.
- All IPs, DCPs, DCPFs, TPs and SPs in the area have been resolved, including with the use of sentinel animals, where appropriate.
- All tracing and surveillance associated with FMD control has been completed satisfactorily, with no evidence or suspicion of infection in the area.
- A minimum period of 28 days[36] has elapsed since depopulation and decontamination were completed on the last IP or DCP in the area.

[36] Consistent with two incubation periods as defined by the OIE

- An approved surveillance program has confirmed no evidence of infection in the RA (see below).

Provided that all these conditions are satisfied, a state or territory can apply to the CCEAD for an RA to be reclassified to 'resolved'. Jurisdictions should present documented evidence that all the above conditions have been met.

A resolved area will have a lower risk status, and the movement restrictions that would apply would be consistent with those applying within a CA.

After a further 28-day period, during which surveillance and monitoring would continue, provided that the additional surveillance and monitoring find no evidence of infection, a jurisdiction could apply to the CCEAD for the resolved area to be reclassified as 'recovered'. This would result in the lifting of the remaining movement controls, and restocking of resolved premises would be allowed.

4.5.1 Approved surveillance programs for reclassifying previously infected areas

Epidemiological expertise should be used to design a surveillance program that will provide a high level of confidence that FMD infection is not present in the RA. Such a surveillance program should be consistent with that envisaged for the final proof-of-freedom stage. As a general rule, it would be expected that all premises with susceptible animals had been visited, the livestock had been inspected, and samples for diagnostic testing had been collected and results reported. Because FMD can be difficult to detect clinically in sheep, serology will be useful to support clinical examination.

The European Commission has published a directive outlining policy for surveillance to support progressive lifting of disease control zones in FMD outbreaks, which may be adapted for the Australian situation.[37]

[37] Articles 36 and 38 in Council Directive 2003/85/EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2003L0085:20110628:EN:PDF

Appendix 1 Recommended movement controls

Stage 3: Recommended movement controls for live susceptible animals within and between areas after RAs and CAs have been set up and the livestock standstill has been lifted, but the outbreak is not considered to be under control

Table A1.1 describes the recommended movement controls for live susceptible animals permitted within and between declared areas. All movements of live susceptible animals to destinations out of an RA are prohibited. The only allowed movements within the RA would be for susceptible animals going either to slaughter or, following a risk assessment, to another ARP, primarily for welfare reasons.

Table A1.1 Recommended movements of live susceptible animals in stage 3

<table>
<tr><th colspan="2" rowspan="2">To / From</th><th colspan="2">RA</th><th colspan="2">CA</th><th rowspan="2">OA</th></tr>
<tr><th>IP/DCP/SP/ TP</th><th>ARP/APF[a]</th><th>SP/TP</th><th>POR/APF[a]</th></tr>
<tr><td rowspan="2">RA</td><td>IP, DCP, SP, TP</td><td colspan="2">Prohibited</td><td colspan="2" rowspan="2">Prohibited</td><td rowspan="2">Prohibited</td></tr>
<tr><td>ARP</td><td>Prohibited</td><td>Prohibited, except under SpP1</td></tr>
<tr><td rowspan="2">CA</td><td>SP, TP</td><td colspan="2">Prohibited</td><td colspan="2">Prohibited</td><td rowspan="2">Prohibited</td></tr>
<tr><td>POR</td><td>Prohibited</td><td>Prohibited, except under SpP2</td><td>Prohibited</td><td>Prohibited, except under SpP3</td></tr>
<tr><td>OA</td><td>OA</td><td>Prohibited</td><td>Prohibited, except under SpP2</td><td>Prohibited</td><td>Prohibited, except under SpP3</td><td>Allowed under normal jurisdictional requirements</td></tr>
</table>

APF = approved processing facility; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

a Meat derived from animals moved from low-risk premises would be considered low risk and is covered by Table A1.4 (Recommended movement of meat, carcases and offal from registered, commercial abattoirs and commercial meat processing enterprises).

Notes for Table A1.1

SpP1 conditions — emergency permit for exceptional circumstances only (ie primarily for welfare reasons):

- **With CVO approval**, for slaughter, or to an ARP for other purposes (eg health and welfare reasons — feed, water, milking), if a risk assessment indicates that the risk associated with movement is acceptable within the response and there are appropriate biosecurity standards in place at the receiving premises.
- Travel by specified route only, and no stopping en route.
- Appropriate biosecurity standard at receiving premises.

- Appropriate decontamination of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Single consignment per load.
- Any suspect clinical signs are immediately reported to the local control centre (LCC) or state control centre (SCC).
- Physical identification of animals (eg National Livestock Identification System (NLIS) or other ear tag, brand), with appropriate accompanying movement documentation (eg National Vendor Declaration (NVD), waybill, PigPass, Sheep Health Statement).

SpP2 conditions — for slaughter only, if the RA contains the only available abattoir:

- For slaughter only, if a risk assessment indicates that the risk associated with the movement is acceptable within the response and there are appropriate biosecurity standards in place at the receiving premises.
- Travel by specified route only, and no stopping en route.
- Appropriate biosecurity standard at receiving premises.
- Appropriate decontamination of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Single consignment per load.
- Any suspect clinical signs are immediately reported to the LCC or SCC.
- Physical identification of animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

SpP3 conditions — for slaughter, or to a POR for other purposes (eg health and welfare reasons — feed, water, milking):

- For slaughter, or to a POR for a specific purpose (eg health and welfare reasons — feed, water, milking), if a risk assessment indicates that the risk associated with movement is acceptable within the response and there are appropriate biosecurity standards in place at the receiving premises. For the purposes of this permit, the definition of POR includes 'approved processing facilities' (ie an abattoir or knackery or other such plant to which animals have been introduced from lower risk premises under a permit for processing to an approved standard).
- Travel by specified route only, and no stopping en route.
- Appropriate decontamination of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Single consignment per load.
- Any suspect clinical signs are immediately reported to the LCC or SCC.
- Physical identification of animals (eg NLIS or other ear tag, brand), with appropriate accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

Stage 4: Recommended movement controls for live susceptible animals within and between areas, when RAs and CAs are in operation and the outbreak is considered to be under control

Table A1.2 describes the recommended movement controls for live susceptible animals permitted within and between declared areas during stage 4 control. All movements of live susceptible animals to destinations out of the RA are prohibited.

Table A1.2 Recommended movements of live susceptible animals during stage 4

<table>
<tr><th colspan="2" rowspan="2">From \ To</th><th colspan="2">RA</th><th colspan="2">CA</th><th rowspan="2">OA</th></tr>
<tr><th>IP/DCP/SP/ TP/RP</th><th>ARP/APF[a]</th><th>SP/TP</th><th>POR/APF[a]</th></tr>
<tr><td rowspan="2">RA</td><td>IP, DCP, SP, TP</td><td colspan="2">Prohibited</td><td colspan="2" rowspan="2">Prohibited</td><td rowspan="2">Prohibited</td></tr>
<tr><td>ARP</td><td>Prohibited</td><td>Prohibited, except under SpP1</td></tr>
<tr><td rowspan="2">CA</td><td>SP, TP</td><td colspan="2">Prohibited</td><td colspan="2">Prohibited</td><td rowspan="2">Prohibited</td></tr>
<tr><td>POR</td><td>Prohibited</td><td>Prohibited, except under SpP2</td><td>Prohibited</td><td>Prohibited, except under GPa</td></tr>
<tr><td>OA</td><td>OA</td><td>Prohibited, except under SpP4</td><td>Prohibited, except under SpP2</td><td>Prohibited</td><td>Prohibited, except under GPb</td><td>Allowed under normal jurisdictional requirements</td></tr>
</table>

APF = approved processing facility; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; GP = general permit; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; RP = resolved premises; SP = suspect premises; SpP = special permit; TP = trace premises

a Meat derived from animals moved from low-risk premises would be considered low risk and is covered by Table A1.4 (Recommended movement of meat, carcases and offal from registered, commercial abattoirs and commercial meat processing enterprises).

Notes for Table A1.2

SpP1 conditions — emergency permit for exceptional circumstances only (ie primarily for welfare reasons):

- **With CVO approval**, for slaughter, or to an ARP for other purposes (eg health and welfare reasons — feed, water, milking), if a risk assessment indicates that the risk associated with movement is acceptable within the response and there are appropriate biosecurity standards in place at the receiving premises.
- Travel by approved route only, and no stopping en route.
- Appropriate biosecurity standard at receiving premises.
- Appropriate decontamination of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Single consignment per load.

- Any suspect clinical signs are immediately reported to the LCC or SCC.
- Physical identification of individual animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

SpP2 conditions — for slaughter only, if the RA contains the only available abattoir:

- For slaughter only, if a risk assessment indicates that the risk associated with the movement is acceptable within the response.
- Travel by approved route only, and no stopping en route.
- Appropriate biosecurity standard at receiving premises.
- Appropriate decontamination of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Single consignment per load.
- Any suspect clinical signs are immediately reported to the LCC or SCC.
- Physical identification of animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

SpP4 conditions — to enable sentinel stock to be introduced:

- **With CVO approval**, for introduction of sentinel stock.
- Travel by approved route only, and no stopping en route.
- Appropriate decontamination of equipment and vehicles, before and after movement.
- Single consignment per load.
- Physical identification of animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

GPa conditions:

- Travel by approved route only.
- Appropriate decontamination[38] of equipment and vehicles, before and after movement.
- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Physical identification of animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

GPb conditions — for slaughter or for movements within an enterprise, such as the movement of offspring from a breeding herd to grow-out unit; not for milking:

- One-way movement only.
- Travel by approved route only.
- Appropriate decontamination[39] of equipment and vehicles, before and after movement.

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[38] Refer to the **Decontamination Manual** for more information on decontamination procedures.

- Absence of clinical signs of FMD in all susceptible animals on the premises before and on day of travel.
- Physical identification of animals (eg NLIS or other ear tag, brand), with accompanying movement documentation (eg NVD, waybill, PigPass, Sheep Health Statement).

Recommended movement controls for semen and embryos from susceptible species

Table A1.3 describes the recommended movement controls within and between declared areas for semen and embryos collected from premises in declared areas and the OA. Timing and location of semen or embryo collection should be considered. Movement of semen and embryos within and between the RA and CA should be restricted to semen and embryos collected at approved, biosecure commercial facilities. To maintain the status of the OA, semen and embryos collected in the RA and CA should not be moved into the OA.

Semen and embryos collected more than 28 days before the estimated time of introduction of the disease is confirmed will be allowed to be moved within and between declared areas and into the OA under a general permit (GPd; see Table A1.3) and will not need to be destroyed. Such movements will require supporting records — that is, evidence of an operational biosecurity manual, including maintenance of biosecurity procedures, accurate record keeping, permanent identification of semen/embryo straws and vials, evidence of adequate disinfection of semen/embryo containers and equipment on leaving the artificial insemination centre and after use on a farm, and certification that the semen or embryos have been stored only with germplasm of equivalent FMD health status and that fresh liquid nitrogen has been used. The semen and embryos that meet these requirements can be used under normal jurisdictional arrangements. However, semen and embryos on IPs and DCPs, no matter when or where they were collected, may need to be destroyed as part of the resolution of the premises.

As well as the risk that semen and untreated embryos may transmit FMDV, there is also a risk associated with the equipment used for transport, insemination and embryo transfer. Therefore, such equipment must be decontaminated (see the **Decontamination Manual** and the **Artificial Breeding Centres Manual** for more detail).

[39] Refer to the **Decontamination Manual** for more information on decontamination procedures.

Table A1.3 Recommended movement of semen and embryos (from locations where collected)

From[a,b] \ To		RA		CA		OA
		IP/DCP/SP/TP	ARP	SP/TP	POR	
RA	IP, DCP, SP, TP	Prohibited		Prohibited		Prohibited
	ARP	Prohibited	Prohibited, except under SpP5	Prohibited	Prohibited, except under SpP5	
CA	SP, TP	Prohibited		Prohibited		Prohibited
	POR	Prohibited	Prohibited, except under SpP5	Prohibited	Prohibited, except under SpP5	
OA	OA	Prohibited	Prohibited, except under GPc	Prohibited	Prohibited, except under GPc	Allowed under normal jurisdictional requirements

ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; GP = general permit; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

a For semen and embryos, this column refers to the location of the premises where the semen or embryos were collected (at the time of collection) and not where they are stored.

b Movement of semen and embryos collected more than 28 days before the estimated time of introduction of the disease is confirmed would need to comply with the conditions of GPd (see notes below).

Notes for Table A1.3

Permits will only be issued for semen and embryos from susceptible species from establishments where applications are accompanied by evidence of:

- an operational biosecurity manual, including maintenance of biosecurity procedures
- accurate record keeping
- permanent identification of all semen/embryo straws and vials.

Permits must not be issued if semen or embryos of higher risk FMD status have been added to the container or in cases where fresh liquid nitrogen has not been used.

SpP5 conditions — once a risk assessment has found that the risk associated with movement is acceptable within the response, including the absence of clinical signs of FMD in all susceptible animals on the collection premises for at least 28 days before the time of collection and for 28 days after collection, and no introductions of susceptible animals onto the property during the 28 days before collection, a permit can be issued with the following conditions:

- Tank or container used for transport is sealed before movement, and disinfected before and after movement.
- If the tank or container used for transport is opened within 28 days of the estimated time of introduction of the disease, a risk assessment is required.
- Information on the identification codes, species and identity of the sire and/or dam, collection date, and property of collection and destination is recorded in the permit.

GPc conditions:

- Tank or container used for transport is sealed before movement and disinfected before and after movement.
- If the tank or container used for transport is opened within 28 days of the estimated time of introduction of the disease, a risk assessment is required.
- Information on the identification codes, species and identity of the sire and/or dam, collection date, and property of collection and destination is recorded in the permit.

GPd conditions — for semen and embryos collected more than 28 days before the estimated time of introduction of the disease is confirmed:

- Tank or container used for transport is sealed before movement and disinfected before and after movement.
- If the tank or container used for transport is opened within 28 days of the estimated time of introduction of the disease, a risk assessment is required.
- Information on the identification codes, species and identity of the sire and/or dam, collection date, and property of collection and destination is recorded in the permit.

Recommended movement controls for meat, carcases and offal

Table A1.4 describes the recommended movement controls for meat, carcases and offal of susceptible animals within and between declared areas.

Table A1.4 Recommended movement of meat, carcases and offal from registered, commercial abattoirs and commercial meat processing enterprises

From \ To	RA	CA	OA
RA (APF)[a]	Allowed	Allowed[b]	Prohibited
CA (APF)[a]	Allowed	Allowed	Prohibited
OA	Allowed	Allowed	Allowed

APF = approved processing facility; CA = control area; OA = outside area; RA = restricted area

a Meat derived from animals moved from low-risk premises would be considered low risk and is covered by the recommended movements of live susceptible animals in stages 3 and 4 (Table A1.1 and Table A1.2, respectively).

b This movement is allowed if a risk assessment indicates that the risk is acceptable within the response. Meat from animals from the RA should only be distributed after maturation and deboning.

Recommended movement controls for effluent and waste

Table A1.5 describes the recommended movement controls for effluent and waste within and between declared areas.

Table A1.5 Recommended movement of effluent and waste

From \ To		RA		CA			OA
		IP/DCP/SP/ TP/ARP	ZP/disposal site	SP/TP[b]	POR	ZP/disposal site	
RA	IP, DCP,	Prohibited	Prohibited, except under SpP6[a]	Prohibited		Prohibited, except under SpP7[a]	Prohibited
	SP, TP[b]	Prohibited	Prohibited	Prohibited		Prohibited	
	ARP	Prohibited	Prohibited, except under SpP6	Prohibited		Prohibited, except under SpP7	
CA	SP, TP[b]	Prohibited	Prohibited	Prohibited		Prohibited	Prohibited
	POR	Prohibited	Prohibited, except under SpP6[c]	Prohibited	Prohibited, except under SpP6	Prohibited, except under SpP6	Prohibited
OA	OA	Prohibited		Prohibited		Prohibited	Allowed under normal jurisdictional requirements

ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises; ZP = zero susceptible stock premises

a Sites receiving effluent and waste from high-risk premises will be designated as DCPs, and an RA would be designated around the site.

b TPs and SPs are temporary classifications, and every effort should be made to resolve the status of these premises as soon as possible.

c This should be the only option available, to minimise the amount of CA effluent and waste being disposed of in RA disposal sites.

Notes for Table A1.5

SpP6 conditions:

- Transport by an approved route.
- The material has been treated or held under conditions that would inactivate FMDV before removal to a disposal site, and there is no leakage of effluent from the vehicle en route.

- Trucks are appropriately decontaminated[40] as soon as possible after use and before leaving the disposal site or POR, and are dry before reuse.
- No direct or indirect contact between the effluent and susceptible animals.
- Movement of effluent is for disposal or decontamination procedures only.

SpP7 conditions:

- **With CVO approval**, for disposal only.
- Transport by an approved route.
- The material has been treated or held under conditions that would inactivate FMDV before removal to a disposal site, and there is no leakage of effluent from the vehicle en route.
- Trucks are appropriately decontaminated[41] as soon as possible after use and before leaving the disposal site, and are dry before reuse.
- No direct or indirect contact between the effluent and susceptible animals.
- Movement of effluent is for disposal or decontamination procedures only.

[40] Refer to the **Decontamination Manual** for more information on decontamination procedures.
[41] Refer to the **Decontamination Manual** for more information on decontamination procedures.

Appendix 2 Procedures for surveillance and proof of freedom

Proof of freedom

Following an outbreak of FMD, surveillance will be required to demonstrate that infection has been eradicated from the population and enable any remaining movement restrictions to be lifted within the country. Proof of freedom will also be needed to satisfy trading partners and regain access to international markets.

The OIE Terrestrial Code (Article 8.5.9) lists the criteria for a previously FMD-free country or zone to be recognised as free of FMD following an outbreak. Reinstatement of Australia's official FMD-free status would require the submission of a formal report to the OIE detailing the eradication procedures, the surveillance program and the results reported. Once the submission is received by the OIE, an international panel of experts reviews the data to determine whether the application for a return to free status is justified.

However, although the OIE provides guidelines for recovering FMD-free status, acceptance of FMD-free status following an outbreak will most likely have to be negotiated with individual trading partners and may take considerably longer than the minimum periods prescribed in the Terrestrial Code.

A key requirement for the OIE and trading partners will be evidence of an effective surveillance program capable of detecting infection if present in the population, and analysis of data to support the case for disease freedom. Descriptions of the veterinary services, demographics of susceptible populations and relevant industry structures should be included to justify the design of the surveillance program.

Principles for designing a post-outbreak surveillance program

To provide confidence that FMDV is no longer circulating[42] a comprehensive surveillance program will be required. This will need to be carefully designed and followed to ensure that it produces sufficient data that are reliable and acceptable to the OIE and international trading partners, while avoiding a program that is excessively costly and logistically complicated. The surveillance program will build on surveillance, tracing and diagnostic testing done during the control phase. The post-outbreak surveillance program should include clinical and serological surveillance, and targeted and random components.

Clinical surveillance

The aim of clinical surveillance is to look for evidence of infection through detecting clinical signs of FMD, by physical examination of susceptible animals. In addition to clinical and/or laboratory investigation of suspect cases reported to authorities (passive surveillance), some active surveillance would also be expected, to look for the disease in groups of animals seen as being at particularly high risk. The absence of FMD infection will support proof of freedom.

[42] According to the OIE, virus circulation means transmission of FMDV as demonstrated by clinical signs, serological evidence or virus isolation.

The approaches used for clinical surveillance will be a continuation of measures in place during the response and should include:

- a public relations and awareness campaign for producers and animal health professionals (veterinarians, stock inspectors, meat inspectors, etc.) to immediately report suspicions of vesicular disease to government veterinary services
- enhanced clinical inspection of livestock at abattoirs, saleyards and other aggregation points
- an official alert system deployed on suspect premises pending diagnosis
- effective veterinary investigations and diagnostic service that demonstrate that suspect cases are promptly investigated
- use of a standardised investigation protocol and reporting forms.

Serological surveillance

Regardless of whether vaccination has been used in the response or not, the Terrestrial Code identifies serological surveillance as a key element for demonstrating FMD freedom. Serological surveillance aims to detect evidence of exposure to FMDV. It may be based on targeted or random sampling or a combination of both. Generally, a targeted approach would be used to verify the status of specific groups or sectors of the population considered to be at higher risk of exposure — for example, herds in former RAs and CAs may be targeted because of proximity to cases, and sheep may be targeted because they are less likely to show clinical evidence of infection than other susceptible species.

Surveys based on random sampling are important in providing reliable evidence that FMDV infection is not present in a country. The sampling strategy will be designed to demonstrate the absence of FMDV circulation at an acceptable level of statistical confidence. Important factors that need to be taken into account when designing the sampling regime include:

- design prevalence — the minimum level of infection that would be detected if the disease is present
- target population — the population under surveillance, which should cover all susceptible species
- level of statistical confidence required in the results
- sensitivity and specificity of diagnostic tests
- sample size — number of herds to be sampled and number of animals to be sampled per herd.

It is impossible to provide specific recommendations to cover all situations, because the characteristics of potential FMD outbreaks in Australia will be highly variable, depending on the strain of virus, the environmental conditions, and the region(s) and populations affected. Technical expertise from professionals who are competent and experienced in epidemiology will be required. Particular attention will need to be paid to selecting an appropriate design prevalence and statistical confidence level for surveys, because these parameters will have to be justified and withstand international scrutiny. Since no diagnostic tests are perfect, the survey design should anticipate the occurrence of false positive reactions and incorporate appropriate follow-up procedures.

Surveillance where vaccination is used

If vaccination is used as part of the FMD response, the options are to remove the vaccinated animals from the population or to allow them to live out their normal commercial lives. The availability of tests that can differentiate infected from vaccinated animals (DIVA tests) means that it may be possible to allow vaccinated animals to be retained in the population to live out their normal lives.

Demonstrating freedom from infection in populations where vaccination has been used will pose additional challenges for post-outbreak surveillance. This is because some vaccinated animals may become infected after exposure to the virus. Although vaccinated herds can still become infected, the transmission of infection may be lower in a vaccinated herd. Therefore, a lower seroprevalence would be expected. This has implications for design prevalence in designing surveys for vaccinated populations. Vaccinated ruminants, but not pigs, may also become carriers if exposed to infection.

DIVA tests are based on detection of antibodies to nonstructural proteins of the virus. These proteins are only expressed as the virus replicates in the host, and are either not present at all or are present at very low levels in purified inactivated vaccines.

In Australia, DIVA testing would be based on an ELISA detecting antibodies to a nonstructural protein (3ABC) of the virus. The test can be used to detect infected animals in a vaccinated population. Animals vaccinated with purified inactivated vaccines but not exposed to live virus are less likely to develop antibodies to 3ABC, but they may develop antibodies after repeated booster vaccinations. It is important to note that, in animals infected after vaccination, antibodies induced by vaccination inhibit, but do not prevent, replication of the virus. Because the virus replicates at much lower levels, the titres of antibodies to nonstructural proteins such as 3ABC are much lower. As a result, the diagnostic sensitivity for vaccinated animals is lower than for animals infected but not vaccinated. This differential sensitivity must also be considered as part of the sampling strategy. For this reason, the 3ABC ELISA is used on a herd basis.

Appendix 3 Persistence of FMDV

The following details of persistence of FMDV in the environment (including animal products and byproducts) supplement the information in Section 1.6.2.

General environment

Reported survival times of FMDV under various conditions include:

- up to 50 days in water (Mahnel et al 1977)
- up to 74 days on pasture at 8–18 °C and high relative humidity
- 26–200 days in soil, sacking, hay or straw, depending on storage or climatic conditions (Morgan 1993)
- up to 35 days on cardboard, wood or metal contaminated with serum, blood or tissue (Gailiunas et al 1969)
- up to 398 days on wood contaminated with fat (Gailiunas et al 1969).

In 1924, the virus persisted for 345 days on one farm in California (Morgan 1993).

Carcases and meat

FMDV is inactivated rapidly once the pH falls below 6.2, which occurs within 3 days in the meat of carcases that have undergone normal post-slaughter acidification. However, prolonged survival of FMDV can occur in meat if the pH does not fall below 6.2. This might happen when carcases are chilled rapidly (Cottral 1960). As well, virus can survive for months in chilled or frozen lymph nodes, bone marrow, viscera and residual blood clots. Deboning and removal of lymph nodes has been an accepted processing strategy for many years.

FMDV may survive for prolonged periods in salted and cured meats (Dhennin et al 1980ab). The virus has been recovered from:

- sausages for up to 56 days
- ham fat for up to 183 days
- bacon for up to 190 days.

OIE recommendations

The OIE Terrestrial Code recommends one of the following procedures for inactivating FMDV in meat:[43]

- Canning

  Meat is subjected to heat treatment in a hermetically sealed container to reach an internal core temperature of at least 70 °C for a minimum of 30 minutes or to any equivalent treatment which has been demonstrated to inactivate the FMD virus.

- Thorough cooking

[43] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm

Meat, previously deboned and defatted, shall be subjected to heating so that an internal temperature of 70 °C or greater is maintained for a minimum of 30 minutes.

After cooking, it shall be packed and handled in such a way that it cannot be exposed to a source of virus.

- Drying after salting

When rigor mortis is complete, the meat must be deboned, salted with cooking salt (NaCl) and completely dried. It must not deteriorate at ambient temperature.

'Drying' is defined in terms of the ratio between water and protein which must not be greater than 2.25:1.

Natural sausage casings

FMDV has been recovered from processed intestinal casings from experimentally infected sheep, stored for 14 days at 4 °C (Bohm 1975, Bohm and Krebs 1974).

Various procedures have been shown to reduce the risk associated with processed items such as sausage casings derived from ruminant and pig intestines (Wijnker et al 2007); OIE recommendations on these materials reflect this work.

OIE recommendations

The OIE Terrestrial Code recommends one of the following procedures for inactivating FMDV in sausage casings derived from ruminants and pigs:[44]

For the inactivation of viruses present in casings of ruminants and pigs, the following procedures should be used: salting for at least 30 days either with dry salt (NaCl) or with saturated brine (Aw < 0.80), or with phosphate supplemented dry salt containing 86.5 percent NaCl, 10.7 percent Na_2HPO_4 and 2.8 percent Na_3PO_4 (weight/weight/weight), and kept at a temperature of greater than 12°C during this entire period.

Dairy products

The survival of FMDV in milk and milk products was reviewed by Morgan (1993), who highlighted the following:

- In milk and butter, virus can survive for 14–45 days, if preserved under cold conditions (Blackwell and Hyde 1976).
- In dried skim milk produced from raw milk, virus can survive for up to 2 years (Cottral 1969).

FMDV has not survived in cheddar cheese cured for longer than 30 days (Blackwell 1976).

The minimum processing required to inactivate FMDV in milk is influenced by:

- the concentration of FMDV in the milk — the higher the concentration of virus, the more severe will be the processing required
- the protective effect on FMDV of milk constituents, especially milk fat and possibly also milk proteins; it has been demonstrated, for example, that a particular heat treatment will destroy a certain concentration of FMDV in skim milk, but not in whole milk or cream

[44] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm

- the strain of FMDV (strains vary in their resistance to heat treatments)
- the nature of the processing
- the pH of the milk during processing and the pH of the finished product
- the period of product storage.

Effect of temperature

Survival time of FMDV in dairy products increases at lower temperatures (especially freezing).

Experimentally, FMDV can survive high temperature – short time (HTST) pasteurisation (72 °C for 15 seconds) (Donaldson 1997). HTST pasteurisation has been shown to reduce virus content in whole milk by an order of 10^4 to 10^5 ID50 per mL (Sellers 1969, Hyde et al 1975). When a temperature of 80 °C is used, virus content is reduced by an order of $10^{5.4}$ to 10^6 ID50 (Hyde et al 1975).

Tomasula et al (2007) showed that residual infectivity was still detectable for selected pasteurised milk samples, as shown by intramuscular and intralingual inoculation of milk into naive steers. HTST pasteurisation did not completely inactivate viral infectivity in whole and 2% fat milk, possibly because a fraction of the virus was protected by the milk fat and the casein proteins. However, it greatly reduced the risk of natural transmission of FMDV by milk.

FMDV can even survive ultra-high temperature (UHT) processing at the lower end of the treatment range (eg 130 °C or 138 °C for 2 seconds) (Walker et al 1984). However, UHT treatment of 148 °C for 2.5 seconds is fully effective (Walker et al 1984).

Since FMDV in milk is not necessarily inactivated by the pasteurisation process required by the Australia New Zealand Food Standards Code (heating at 72 °C for 15 seconds and immediate shock cooling to 4.5 °C (ANZFA 2000)), further processing may be required if the milk is for human consumption and has a pH of 7.0 or above (see below), and if the treated product is to be fed to animals. UHT treatments at the upper end of the treatment range can also be used.

Effect of moisture levels

Inactivation of viruses depends on water activity. Many viruses survive for long periods and at high temperatures in environments with low water activity. Several methods can be used to produce milk powder, including plate drying and spray drying. Spray drying is likely to be less effective than plate drying in inactivating FMDV because the process flashes off the water almost instantly, with little damage to proteins and lipids. Unfortunately, very little information is available on the inactivation of FMDV in dry products.

Low moisture levels increase the resistance of FMDV to heat. In dried tissue products, the virus may remain active after 1 minute at 130 °C, 3 minutes at 120 °C, 5 minutes at 110 °C, and 2.5 hours at 70 °C (Dimopoullos 1960).

Dried casein produced from pasteurised milk of dairy cows infected with FMDV retained infectivity for cattle in one of seven tests after storage at 25 °C for 42 days (Cunliffe et al 1978). The whey byproduct from casein manufacture was noninfective.

Production of dried milk powder by spray drying of FMDV-contaminated milk, to reduce the moisture to not more than 6.7%, reduced the viral titre by only 1 log (from 5 log). The

residual virus remained viable for at least 2 years, with a titre reduction of only 2.1–3.4 log over that period. Heating the contaminated dry milk powder for 60 minutes at 100 °C reduced the titre by 1.5 log. However, all virus was destroyed within 20 minutes at 120 °C (Nikitin and Vladimirov 1965).

Effect of pH

FMDV is most stable in the pH range 7.2–7.6. Milk from cows infected with FMDV can have an elevated pH, typically in the range 7.0–7.5 (normal pH of milk is approximately 6.6), but pH values as high as 7.7 have been recorded. To achieve the same level of destruction, more severe processing is required for milk with a pH above 7.0 than for milk at a normal pH. For example:

- 4 °C, pH 5.5 — inactivation in 30 minutes
- 72 °C, pH 6.7 — inactivation in 17 seconds
- 72 °C, pH 7.6 — inactivation in 55 seconds.

The level of any residual FMDV in the finished product will gradually diminish over time, and eventually become nondetectable. However, complete die-out can take many months. Thus, short-hold products present a higher risk of transmission than long-hold products. The pH of the finished product will influence the die-out rate; the lower the product pH, the faster the die-out rate during subsequent storage. At pH levels below 5.5, the die-out rate is much faster.

OIE recommendations

The OIE Terrestrial Code takes into account the end use of the dairy product in making the following recommendations regarding the inactivation of FMDV:[45]

- Milk and cream for human consumption

For the inactivation of viruses present in milk and cream for human consumption, one of the following procedures should be used:

1. a sterilisation process applying a minimum temperature of 132 °C for at least one second (UHT)
2. if the milk has a pH less than 7.0, a sterilisation process applying a minimum temperature of 72 °C for at least 15 seconds (HTST pasteurisation)
3. if the milk has a pH of 7.0 or over, the HTST process applied twice.

- Milk for animal consumption

For the inactivation of viruses present in milk for animal consumption, one of the following procedures should be used:

1. the HTST process applied twice
2. HTST combined with another physical treatment, eg maintaining a pH 6 for at least one hour or additional heating to at least 72 °C combined with desiccation
3. UHT combined with another physical treatment referred to in point 2 above.

[45] www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.8.5.htm

Wool, hides and skin

Approximate survival times of FMDV in wool, hides and skin are (McColl et al 1995):

- 7 weeks at 4 °C storage
- 2 weeks at 18 °C storage
- 2 days at 37 °C storage.

Persistence of the virus in skin tissue is determined by the rate of degradation as a result of acidification. Salting or refrigeration of skins retards degradation and allows the virus to persist. Unprocessed skins that may be contaminated with FMDV should be buried, burned, or disinfected before further processing. Fully processed skins are a negligible disease risk (Williams 2003).

FMDV has been recovered from green salted hides for up to:

- 90 days at 15 °C
- 352 days at 4 °C.

Hides cured for 20 hours in saturated brine with up to 500 ppm of available chlorine still had detectable FMDV after 4 weeks of storage at 15 °C. FMDV was also detected in a hide sample dried for 42 days at 20 °C and 40% relative humidity.

Hides cured in salt for 7 days and then dried at 20 °C were found to be infectious for 21 days.

FMDV has been recovered from wool from infected sheep following natural exposure (McColl et al 1995). Virus could be recovered from greasy wool for up to 14 days after experimental contamination.

Factors influencing survival of FMDV on wool and fibre include the presence of organic material (eg faeces), temperature and relative humidity in storage.

Infrastructure to inactivate FMDV in wool is extremely limited in Australia. There are wool processors in Geelong and Laverton (Victoria) and in Salisbury (South Australia); more than 95% of Australia's wool clip is currently exported to China as raw greasy wool for processing. For alpacas, Australia sends raw greasy wool to Peru for processing (scouring and spinning); there are no scourers of alpaca wool in Australia, and only one spinner (in Wangaratta, Victoria). This spinner requires 100 tonne per order, which is unlikely to be supplied by the Australian alpaca industry.

OIE recommendations

The OIE Terrestrial Code makes the following recommendations regarding the inactivation of FMDV in wool, hair and bristles:

> For the inactivation of viruses present in wool and hair for industrial use, one of the following procedures should be used:
>
> - industrial washing, which consists of the immersion of the wool in a series of baths of water, soap and sodium hydroxide (soda) or potassium hydroxide (potash)
> - chemical depilation by means of slaked lime or sodium sulphide

- fumigation in formaldehyde in a hermetically sealed chamber for at least 24 hours. The most practical method is to place potassium permanganate in containers (which must NOT be made of plastic or polyethylene) and add commercial formalin; the amounts of formalin and potassium permanganate are respectively 53 mL and 35 g per cubic metre of the chamber
- industrial scouring which consists of the immersion of wool in a water-soluble detergent held at 60–70 °C
- storage of wool at 18 °C for 4 weeks, or 4 °C for 4 months, or 37 °C for 8 days.

For the inactivation of viruses present in bristles for industrial use, one of the following procedures should be used:

- boiling for at least one hour
- immersion for at least 24 hours in a 1% solution of formaldehyde prepared from 30 mL commercial formalin per litre of water.

Animal excretions

FMDV has been shown to survive in animal manure for the following periods (Bauer and Eissner 1972, Rozov and Andryunin 1972, Callis et al 1980):

- dry manure — 14 days
- moist manure — 8 days
- 30-cm manure mounds or piles — less than 6 days
- liquid manure — 34–42 days at 12–22 °C
- water from pen washings — 21 days at 17–21 °C.

FMDV may be able to survive in the urine of susceptible species and has been recorded as persisting in urine for up to 7 days, as reviewed by Cottral (1969); persistence of virus in urine will depend on temperature and pH.

Tissue fluids and blood

Virus in tissue fluids or blood allowed to dry on various materials and kept indoors at room temperature may remain infective for the following periods (APHIS 1980, McKercher and Callis 1983):

- up to 2 weeks on wool
- 4 weeks on cows' hair
- 11 weeks on boot leather
- 13 weeks on rubber boots
- 15 weeks on hay
- 20 weeks on bran.

Semen

Virus has been recovered from bovine semen stored at –50 °C for 320 days (Cottral et al 1968).

Appendix 4 Zoning for international trade

The World Organisation for Animal Health (OIE) defines a zone or region as a clearly defined part of a territory containing an animal subpopulation with a distinct health status, with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

The OIE recommendations for FMD-free zones are given in Articles 8.5.4 (for zones where vaccination is not practised) and 8.5.5 (for zones where vaccination is practised) of the OIE Terrestrial Code.

It has been agreed that, in the event of an FMD outbreak, a whole state or territory would initially be declared as the CA, rather than the entire country. This would allow unaffected states and territories to be proposed as FMD free, to minimise trade disruption. As soon as possible, the CA would be reduced and aligned with shires and local government areas. Infected and free zones would be based on the epidemiology of the outbreak, a determination that could be defended to overseas countries.

The OIE Terrestrial Code (Article 8.5.8) allows for the establishment of a containment zone in the event of limited outbreak(s) within an FMD-free country or zone with or without vaccination. A containment zone includes all cases and thus may help to minimise the impact of an FMD outbreak on the entire country or zone. For this to be achieved, Australia's veterinary authority[46] would need to provide documented evidence that:

1. the outbreaks are limited, based on the following factors:
    a. immediately on suspicion, a rapid response including notification has been made
    b. standstill of animal movements has been imposed, and effective controls on the movement of other commodities mentioned in this [the FMD] chapter of the Terrestrial Code are in place
    c. epidemiological investigation (trace-back, trace-forward) has been completed
    d. the infection has been confirmed
    e. the primary outbreak has been identified, and investigations on the likely source of the outbreak have been carried out
    f. all cases have been shown to be epidemiologically linked
    g. no new cases have been found in the containment zone within a minimum of two incubation periods [ie 28 days] after the stamping-out of the last detected case is completed
2. a stamping-out policy has been applied
3. the susceptible animal population within the containment zone should be clearly identifiable as belonging to the containment zone
4. increased passive and targeted surveillance in accordance with Articles 8.5.42 to 8.5.47 and Article 8.5.49 in the rest of the country or zone has been carried out and has not detected any evidence of infection

[46] Australian Chief Veterinary Officer or the Australian Government Department of Agriculture; see also glossary

5. animal health measures that effectively prevent the spread of the FMDV to the rest of the country or zone, taking into consideration physical and geographical barriers, are in place
6. ongoing surveillance in the containment zone is in place.

The OIE Terrestrial Code also states that the free status of the areas outside the containment zone would be suspended pending the establishment of the containment zone. The free status of these areas could be reinstated, irrespective of the provisions of Article 8.5.9 (recovery of free status), once the containment zone is clearly established, as outlined above. The containment zone would need to be managed in such a way that it can be demonstrated that commodities for international trade have originated outside the containment zone.

The recovery of the FMD-free status of the containment zone would need to follow the provisions of Article 8.5.9.

Australia's veterinary authority would manage international issues and liaison during an outbreak. To have FMD-free zones accepted as such, Australia's veterinary authority would need to:

- work in parallel with the state control centre handling disease control activities
- obtain evidence of freedom from nonaffected areas or states
- make a case for continued export from nonaffected states — for example, by amended certification and inspection systems
- after the initial international declaration of infection based on an entire state, use pre-established surveillance systems and other information to demonstrate zonal freedom to the OIE and recipient countries in accordance with the OIE Terrestrial Code
- make use of precedents (eg the 2007 outbreak in the United Kingdom).

As zoning will require considerable resources that could otherwise be used to control an outbreak, careful consideration will need to be given to prioritise these activities. In practice, acceptance of zoning will be subject to bilateral agreement between the veterinary services of Australia and its trading partners (see Section 3.2.4).

Appendix 5 Vaccination strategies

Introduction

Australia's response policy for FMD is for containment and eradication as rapidly as possible to minimise the impacts. Vaccination may be considered if the disease spreads beyond the limit of available resources to contain it, to protect areas of high animal concentrations, and to limit infection and minimise virus excretion.

FMD vaccines will protect animals against clinical disease. Although vaccination may not entirely prevent infection, effective vaccines reduce susceptibility to infection. If infection does occur, vaccination reduces the amount of virus shed into the environment. These two factors mean that vaccination may be a valuable tool to assist with eradication of FMD in Australia under some circumstances.

Biosecurity practised by all field teams is critical to the success of a vaccination program.

Vaccination can be used in three broad ways: protective, suppressive and mass (blanket) vaccination.

Also refer to the relevant nationally agreed standard operating procedures, including:

- NASOP 1: Personal decontamination — entry and exit procedures[47]
- NASOP 14: Control of foot and mouth disease vaccine at a designated vaccine centre[48]
- NASOP 16: Assessing and inspecting a property prior to administration of foot and mouth disease vaccine[49]
- NASOP 17: Vaccinating livestock on a property for foot and mouth disease[50]
- NASOP 24: Ordering of foot and mouth disease vaccine and distribution to states and territories.[51]

Protective vaccination

Protective vaccination involves vaccination of particular groups of animals in an area to protect them from clinical disease or infection. Vaccination would generally be undertaken **outside** the known infected area (ie restricted areas) and in advance of exposure. Protective vaccination can be considered further in terms of how it is applied: ring, targeted or buffer vaccination.

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47 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Personal-decontamination-entry-and-exit-procedure.pdf

48 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Control-of-FMD-vaccine-at-a-designated-vaccination-centre.pdf

49 www.animalhealthaustralia.com.au/wp-content/uploads/2011/04/Assessing-and-inspecting-a-property-prior-to-admin-FMD-vaccine.pdf

50 www.animalhealthaustralia.com.au/wp-content/uploads/2012/06/Vaccinating-livestock-on-a-property-for-FMD.pdf

51 www.animalhealthaustralia.com.au/wp-content/uploads/2012/06/Ordering-of-FMD-vaccine-and-distribution-to-states-and-territories.pdf

Ring vaccination

Ring vaccination builds a ring of immune animals around a focus of infection to prevent further outward spread of the disease. The width of the 'ring' depends on the likely distance that the virus will move. It is an appropriate technique when premises adjacent to, or close to, a focus of infection are considered at risk of becoming infected. It is most effective in reducing the size of outbreaks when used early, and when the disease is spreading rapidly. Vaccination teams would normally begin working from the outer edge of the ring inwards to reduce the risk of spreading infection.

Targeted vaccination

With targeted vaccination, selected groups or individuals are vaccinated to protect them. This particularly applies to valuable commercial animals (eg high-value genetic stock), or rare or valuable animals or herds (eg zoo animals). Alternatively, it might be considered to protect high-risk enterprises, such as feedlots, large dairies or large piggeries. Because of the large numbers of animals in close contact in these enterprises, they have the potential to rapidly amplify and excrete FMDV. Even where these enterprises are not directly involved in the outbreak, they may be a risk because of their proximity to a source of infection. If they were to become infected, they could significantly increase the response effort.

Buffer vaccination

Buffer vaccination is undertaken to create a barrier of immune stock between a heavily infected zone and an area that is free from disease. Animals in a 'band' of properties along the notional border between the two areas are vaccinated to create a buffer population. Vaccination teams would normally begin working from the outer edge of the ring inwards to reduce the risk of spreading infection.

Suppressive vaccination

Suppressive vaccination is the vaccination of a selected group of animals at risk from an outbreak, to control the spread of FMD within and out of an area that is already infected. Vaccination is carried out **within** the known infected area where it is considered that there is an urgent need to reduce the amount of virus circulating and hence the risk of spread within and beyond the area. It reduces the amount of FMDV circulating in the area because vaccinated animals, if infected, excrete substantially less virus than fully susceptible animals (Sellers et al 1977). Afterwards, all vaccinated animals may either be removed, or tested using DIVA technology to establish which herds have not been infected. Uninfected herds may be retained in the population, while infected herds are removed. The post-vaccination strategy will depend on the extent of disease spread during the outbreak and the availability of resources.

Suppressive vaccination is used where there is a recognised risk of escalation of the outbreak, to prevent spread within and beyond the restricted area. It may be indicated when:

- there is a high density of animals (especially pigs and feedlots)
- the capacity to cull and dispose of carcasses of culled animals within a short period has been overwhelmed (eg in feedlots)
- infrastructure is poor, human resources are inadequate or stamping out is delayed.

Suppressive vaccination may have a role where stamping out is planned but is logistically or politically difficult to implement. Vaccination could reduce the risk associated with delayed destruction. Slaughter of vaccinated animals can then be carried out in a progressive,

orderly manner. In 2001, the Netherlands used a suppressive vaccination strategy to address logistical problems associated with culling and disposing of animals in infected areas.

Mass (blanket) vaccination

Mass vaccination is vaccination of large numbers of animals over a wide area to protect them from infection and/or disease. It would generally be used where FMD was widespread and not readily containable using other measures. At least initially, the disease would be considered endemic, and a longer term control program would be required to achieve eradication.

Decision criteria

The following decision criteria are intended to be used with the FMD vaccination decision tree (Figure A4.1 at the end of this appendix). The decision tree identifies three decision components:

- initial assessment
- vaccination strategy
- vaccinated animal management strategy.

Initial assessment — a role for vaccination?

The key issue in choosing the preferred strategy for managing an FMD outbreak is the extent to which the disease can be controlled with available resources. This will largely be determined by where the outbreak has occurred, the time since the disease was first introduced, and the extent to which the disease has spread across and within industry sectors. Eradication by stamping out may be feasible if the disease was introduced relatively recently and occurs on circumscribed properties within a single compartment. In contrast, containment and control may be more difficult for an outbreak in a high-density livestock production area where there is already evidence of spread across and between different industry sectors.

The criteria in Table A5.1 should be used in assessing whether vaccination is likely to be of benefit in any given outbreak setting.

Table A5.1 Criteria for assessing benefits of FMD vaccination

Criterion	For vaccination	Against vaccination
Location	Significant livestock producing area	Isolated farm
Lifetime traceability in place or available for vaccinates	Yes	No
Livestock density (numbers of premises, livestock in immediate vicinity, feedlots, etc)	High	Low
Extent of movements (livestock, product, fomites, wildlife) that have occurred in and around infected premises	Extensive	Limited
Evidence of spread	Evidence of multiple outbreaks involving different industry sectors	Little evidence of spread
Slope of epidemic curve	Rising rapidly	Shallow or slow rise
Likelihood of future spread	Potential to enter multiple properties in different compartments	Extensive spread considered unlikely
Conditions suitable for airborne spread	Yes	No
Spatial distribution of outbreaks	Widespread	Restricted
Suitable vaccine available	Yes	No
Resource availability for stamping out, including timely destruction, disposal and decontamination	Limited	Adequate
Resources for vaccination (adequate vaccine stocks that can be accessed quickly, trained personnel, other logistics)	Adequate	Limited
Industry support for stamping out	Low	High
Public reaction to stamping-out policy	Opposed	Supportive
Market acceptance of product from vaccinated animals	Supportive	Opposed

Vaccination strategy — what strategy to use?

In addition to deciding **whether** to use vaccination, it is also necessary to consider **how** vaccination should be used. This includes both the strategy and the species to be vaccinated. The preferred strategy will depend on a range of factors, including:

- amount of vaccine available relative to the numbers of animals at risk
- resources for vaccination
- density of animals (especially pigs)
- capacity to perform effective stamping out
- risk that the disease will get out of control
- presence of rare or endangered animals
- presence of high-risk enterprises (feedlots, large dairy farms, intensive piggeries)
- industry attitudes
- public and political concerns
- surveillance capacity
- acceptance of DIVA technology in target species by trading partners.

Ring vaccination around the infected area(s) could be considered where there is a risk that the outbreak could rapidly escalate. Where stamping out is not feasible because resources are insufficient or the disease has entered a compartment where further spread is inevitable (because of poor biosecurity), suppressive vaccination should be considered. In a large multifocal outbreak where disease is spreading rapidly, mass vaccination may be necessary to bring the situation under control.

The criteria in Table A5.2 may be used to assist in determining the preferred vaccination strategy. (Note that the criteria do not indicate which species would be vaccinated.)

Table A5.2 Criteria for determining FMD vaccination strategy

Criterion	Protective ring vaccination	Targeted vaccination	Suppressive vaccination	Mass vaccination
Vaccine availability	Limited	Limited	Limited	Ample
Resources to maintain effective stamping out	Adequate, but escalation possible	Adequate, but protection of selected animals desirable	Inadequate	Inadequate
Short-term capacity to cull animals and dispose of carcasses overwhelmed	No	No	Yes	No
Spatial distribution	Multiple outbreaks with possible future resource problems	Limited or multiple outbreaks	Multiple outbreaks with current resourcing problems	Multifocal or multijurisdictional and out of control
Species at risk	Predominantly ruminants	Predominantly ruminants	Significant numbers of pigs	Various
Rare or endangered animals at risk	No	Yes	No	No
Regional characteristics	High-density, high-value livestock	High-value (rare or endangered) animals, high-risk enterprises	High-density livestock	Various
Species to vaccinate	Ruminants only	Various	All susceptible species	Various

Vaccinated animal management strategy — how to manage vaccinated animals?

If vaccination is used, the options are to allow vaccinated animals to remain in the population and live out their normal commercial lives, or to remove them from the population. If vaccinated animals are to be removed, how quickly this is to be achieved needs to be considered.

Monetary incentives to expedite removal may be considered. This would lead to the concepts of 'voluntary' removal (in response to an incentive) and 'mandatory' removal (in response to a destruction order).

Although there are technical considerations, ultimately the decision to keep or remove vaccinated animals is a socioeconomic one. To minimise the long-term impacts of an FMD outbreak, it will be essential for Australia to regain its FMD-free status and re-establish internal and export markets. Under current conditions, presence of FMD-vaccinated animals in the population would be expected to cause access difficulties in many of Australia's traditional markets.

The criteria in Table A5.3 can be used to assist in determining the preferred strategy for managing vaccinated animals.

Table A5.3 Criteria for determining strategy for managing FMD-vaccinated animals

Criterion	Nonremoval of vaccinates	Removal of vaccinates
Number of vaccinated animals	Large	Small
Markets available for vaccinated animals and their products	Yes	No
Compensation or assistance measures for removing vaccinated animals	Not available	Available
Regionalisation after vaccination	Accepted by trading partners	Not accepted
Surveillance and laboratory resources to carry out post-vaccination surveillance	Strong	Weak
Reliable DIVA technology	Available	Not available
Industry attitudes and producer impacts favour retention of vaccinated stock	Yes	No
Industry attitudes favour ongoing restrictions on vaccinated animals	Yes	No
Public or political outrage over destruction of healthy vaccinated animals	High	Low
Lifetime traceability available	Yes	No

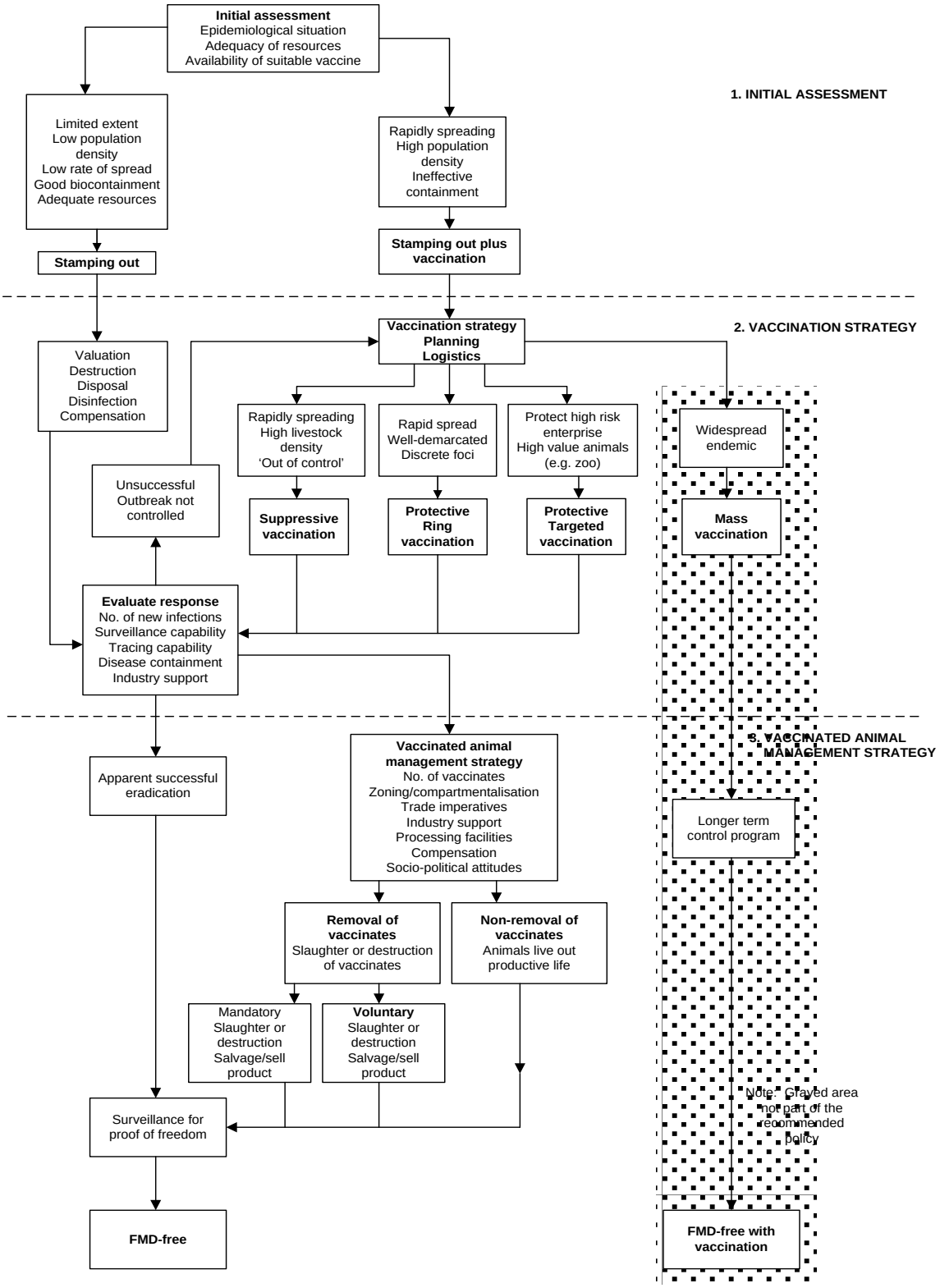

Figure A5.1 FMD vaccination decision tree

Appendix 6 Features of FMD

Disease and cause

Foot-and-mouth disease (FMD) is a highly contagious viral disease of all cloven-hoofed animals, caused by a picornavirus. Although not lethal in adult animals, it causes serious production losses.

Species affected

All cloven-hoofed animals are affected, including cattle, sheep, pigs, goats, camels, alpacas and deer. Horses are not susceptible. Humans do not become infected by eating meat from affected animals.

Distribution

FMD is endemic throughout the Middle East, Africa, Asia and most of South America. Indonesia, Papua New Guinea, New Zealand, the Pacific Island nations, the Philippines and parts of Malaysia are free from FMD. The disease was last recorded in Australia in 1872.

Key signs

The incubation period for regulatory purposes is 14 days. The first sign is generally an elevated temperature. One of the key signs is fluid-filled vesicles (blisters) on the tongue and in the mouth, which cause the animal, particularly cattle, to salivate excessively. Lameness is a frequent sign as a result of vesicles on the feet above the claw and between the digits. Vesicles may also occur on the teats and udder. Milk yield drops considerably in dairy species.

Most diseased animals will recover in about 2 weeks. Mortality does not normally exceed 5%, but may be very high in young animals. However, the first cases may not show dramatic clinical signs, even in FMD-free countries. Recovered animals continue to have reduced productivity.

The disease is usually mild in sheep and goats, with few lesions.

Spread

FMD is one of the most contagious animal diseases. Infected animals excrete virus in the fluid from ruptured vesicles, exhaled air, saliva, milk, semen, faeces and urine. Virus transmission can begin up to 4 days before the appearance of vesicles. The primary means of transmission within herds and flocks is by direct contact, via respiratory aerosols. Pigs are potent excretors of airborne virus.

Spread of infection between properties and areas is frequently due to movement of infected animals or contaminated vehicles, equipment, people and products. Windborne spread of infected aerosols can occur for many kilometres under the right climatic conditions.

Persistence of the virus

FMDV may remain infective in the environment for several weeks. Low temperatures and high humidity increase virus survival times. Although the virus is inactivated within 3 days in carcases that have undergone normal post-slaughter ageing, it can survive for months in chilled lymph nodes, bone marrow, viscera and blood clots. It can also survive for long periods in salted and cured meats. FMDV has been detected in the milk and semen of experimentally infected cattle for 23 and 56 days, respectively. Some recovered ruminants can become carriers, but there is no conclusive field evidence for domestic ruminants transmitting infection to susceptible animals. Pigs do not become carriers. The virus is susceptible to most disinfectants.

Glossary

Agriculture Ministers' Forum	The forum of Australian national, state and territory and New Zealand ministers of agriculture that sets Australian and New Zealand agricultural policy (formerly the Primary Industries Ministerial Council). *See also* Animal Health Committee
Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hoofs, bones, fertiliser).
Animal Health Committee	A committee whose members are the Australian and state and territory CVOs, the Director of the CSIRO Australian Animal Health Laboratory, and the Director of Environmental Biosecurity in the Australian Government Department of the Environment. The committee provides advice to the Agriculture Ministers' Forum on animal health matters, focusing on technical issues and regulatory policy (formerly called the Veterinary Committee). *See also* Agriculture Ministers' Forum
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility that maintains increased biosecurity standards. Such a facility could have animals or animal products introduced from lower risk premises under a permit for processing to an approved standard.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. *See also* Chief veterinary officer
AUSVETPLAN	*Aus*tralian *Vet*erinary Emergency *Plan*. A series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

Biological products	Reagents of biological origin (eg sera, hormones) for therapeutic use in the diagnosis or treatment of certain diseases.
Bos indicus cattle breeds	*See* Zebu
Bos taurus cattle breeds	European breeds of cattle, including friesian, hereford, jersey, shorthorn.
Carrier	A ruminant in which virus can be intermittently found in the oropharyngeal area for more than 28 days after infection, often without the animal displaying clinical disease. The role of carrier animals other than African buffalo in the ongoing transmission of FMD virus has not been demonstrated.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. *See also* Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with OIE guidelines, based on applied biosecurity measures and surveillance, in order to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. *See also* Emergency Animal Disease Response Agreement
Confidence	A measure of reliability. For proof of freedom surveillance, confidence refers to the probability of detecting infection in the population if it is present at or above a specified level (the design prevalence).
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory CVOs, representatives of CSIRO-AAHL and the relevant industries, and the Australian CVO as chair.
Control area	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Coronet (coronary band)	Band around the top of the hoof.

Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery or milk processing plant (or other such facility) that, after investigation and based on a risk assessment, is considered to contain a susceptible animal(s) not showing clinical signs, but considered highly likely to contain an infected animal(s) and/or contaminated animal products, wastes or things that present an unacceptable risk to the response if the risk is not addressed, and that therefore requires action to address the risk.
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility that, based on a risk assessment, appears highly likely to have received infected animals, or contaminated animal products, wastes or things, and that requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. There are two types of declared areas: restricted area and control area.
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Design prevalence	For proof of freedom surveillance, the minimum proportion of infected/exposed animals or farms in the population that the surveillance system is designed to detect with a certain level of statistical confidence.
Destroy (animals)	To kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases — 1800 675 888.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
Disinsectation	The destruction of insect pests, usually with a chemical agent.

Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
ELISA (enzyme-linked immunosorbent assay)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. *See also* Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN.
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. *See also* Emergency animal disease, Exotic animal disease
Enterprise	*See* Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. *See also* Veterinary investigation
Epidemiology	The study of disease in populations and of factors that determine its occurrence.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. *See also* Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	*See* Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.

General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* Special permit
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of the pathogen into the animal and the first clinical signs of the disease.
Index case	The first case of the disease to be diagnosed in a disease outbreak. *See also* Index property
Index property	The property on which the index case is found. *See also* Index case
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease exists, or there is a reasonable suspicion that either exists, and that the relevant chief veterinary officer or their delegate has declared to be an infected premises.
Laminitis	Inflammation of the sensitive laminae of the hoof.
Local control centre (LCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.

Milk and milk products	Includes (from all FMD-susceptible species): • raw milk • milk and other dairy products for human consumption or use • milk and other dairy products for human consumption or use that are diverted to animals — for example, surplus milk or milk past its expiry date • bathing milk and other beauty products containing dairy products • production waste, including washings and wastewater from farms, processing and retail premises that are contaminated with dairy products • pet milk and manufactured unpelleted stock feed, including milk replacer for calves and lambs • pharmaceuticals and other products containing dairy products intended for use in animals, such as extenders used in artificial breeding.
Monitoring	Routine collection of data for assessing the health status of a population. *See also* Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National Management Group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	*See* Wild animals
OIE Terrestrial Code	OIE *Terrestrial Animal Health Code*. Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: www.oie.int/international-standard-setting/terrestrial-code/access-online
OIE Terrestrial Manual	OIE *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals*. Describes standards for laboratory diagnostic tests and the production and control of biological products (principally vaccines). The current edition is published on the internet at: www.oie.int/international-standard-setting/terrestrial-manual/access-online
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.

Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Plume (virus)	A dense aerosol of virus particles capable of moving over large distances on air currents.
Polymerase chain reaction	A method of amplifying and analysing DNA sequences that can be used to detect the presence of viral DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, suspect premises, trace premises, dangerous contact premises or dangerous contact processing facility.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Quarantine	Legal restrictions imposed on a place or a tract of land by the serving of a notice limiting access or egress of specified animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures and is subject to the procedures and restrictions appropriate to the area in which it is located.
Restricted area	A relatively small legally declared area around infected premises and dangerous contact premises that is subject to disease controls, including intense surveillance and movement controls.
Risk assessment	Evaluation of the likelihood and consequences of entry, establishment and spread of a disease agent. Risk assessment does not necessarily require a formal documentary process.
Risk enterprise	A defined livestock or related enterprise that is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots.

Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. *See also* Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	Appearance in the blood serum of antibodies following vaccination or natural exposure to a disease agent.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in the test serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Slaughter	The humane killing of an animal for meat for human consumption.
Special permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. *See also* General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. *See also* Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
State coordination centre (SCC)	The emergency operations centre that directs the disease control operations to be undertaken in that state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.

Susceptible animals	Animals that can be infected with a particular disease.
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. *or* An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises (SP)	Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s).
Swill	Also known as 'prohibited pig feed', material of mammalian origin, or any substance that has come in contact with this material; it does not include: • milk, milk products or milk byproducts, either of Australian provenance or legally imported for stockfeed use into Australia • material containing flesh, bones, blood, offal or mammal carcases that is treated by an approved process • a carcass or part of a domestic pig, born and raised on the property on which the pig or pigs that are administered the part are held, that is administered for therapeutic purposes in accordance with the written instructions of a veterinary practitioner • material used under an individual and defined-period permit issued by a jurisdiction for the purposes of research or baiting.
Swill feeding	Also known as 'feeding prohibited pig feed', includes: • feeding, or allowing or directing another person to feed, prohibited pig feed to a pig • allowing a pig to have access to prohibited pig feed • the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept • supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig.
TCID50	Tissue culture infectious dose — a measure of virus concentration or dose. Serial dilutions of virus are added to susceptible cells in culture. The dilution of virus at which half of the cultures are infected is called the TCID50.
Trace premises (TP)	Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to the disease agent, or contains contaminated animal products, wastes or things, and that requires investigation(s).
Tracing	The process of locating animals, persons or other items that may be implicated in the spread of disease, so that appropriate action can be taken.

Unknown status premises (UP)	A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.
Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products, or a synthetic substitute, which is treated to act as an antigen without inducing the disease.
– adjuvanted	A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).
– attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
– gene deleted	An attenuated or inactivated vaccine in which genes for nonessential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A *biological* vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A *mechanical* vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Vesicular disease	Any disease in which intact, ruptured or healing blisters, papules or ulcers may be evident on skin or mucosal surfaces.

Veterinary authority	According to the OIE *Terrestrial Animal Health Code*, the veterinary authority is a country's government authority, comprising veterinarians, other professionals and para-professionals, having the responsibility and competence for ensuring or supervising the implementation of animal health and welfare measures, international veterinary certification and other standards and recommendations in the Terrestrial Code in the whole territory. In Australia, the veterinary authority is the Australian Chief Veterinary Officer or the Australian Government Department of Agriculture.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. *See also* Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
– native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
– feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
– exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
Zebu (cattle)	Bovine animals (*Bos indicus*) with a characteristic large hump over the shoulders. Widely distributed in India, China, eastern Africa, etc, and used for cross-breeding in Africa and northern parts of Australia.
Zero susceptible stock premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with OIE guidelines, based on geopolitical and/or physical boundaries and surveillance, in order to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

AAHL	Australian Animal Health Laboratory
AN	assessed negative
APF	approved processing facility
ARP	at-risk premises
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DCPF	dangerous contact processing facility
DIVA	differentiating infected from vaccinated animals
EAD	emergency animal disease
ELISA	enzyme-linked immunosorbent assay
FMD	foot-and-mouth disease
FMDV	foot-and-mouth disease virus
GP	general permit
HTST	high temperature – short time (pasteurisation)
IP	infected premises
LCC	local control centre
NLIS	National Livestock Identification System
NMG	National Management Group
NVD	National Vendor Declaration
OA	outside area

OIE	World Organisation for Animal Health
PCR	polymerase chain reaction
POR	premises of relevance
RA	restricted area
RH	relative humidity
SP	suspect premises
SpP	specific permit
TP	trace premises
UHT	ultra-high temperature
UK	United Kingdom
ZP	zero susceptible stock premises

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Video/training resources

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