AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Response strategy

Anthrax

Version 5.1

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

National Biosecurity Committee

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1 Introduction

1.1 This manual

1.1.1 Purpose

As part of AUSVETPLAN (the Australian Veterinary Emergency Plan), this response strategy contains the nationally agreed approach for the response to an incident – or suspected incident – of anthrax in Australia. It has been developed to guide decision making to ensure that a fast, efficient and effective response can be implemented consistently across Australia with minimal delay.

1.1.2 Scope

This response strategy covers -- caused by Bacillus anthracis.

This response strategy provides information about:

- the disease (Section 2)
- the implications for Australia, including potential pathways of introduction; social, environmental, human health and economic effects; and the critical factors for a response to the disease (Section 3)
- the agreed policy and guidelines for agencies and organisations involved in a response to an outbreak (Section 4)
- declared areas and premises classifications (Section 5)
- biosecurity controls, including quarantine and movement controls (Section 6)
- response surveillance and establishing proof of freedom (Section 7).

The key features of Anthrax are described in the **anthrax fact sheet** (Appendix 1).

1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak ofdisease name - clinical -- are based on risk assessment. They are informed by the recommendations in the World Organisation for Animal Health (WOAH) *Terrestrial animal health code* (Chapter 8.1) and the WOAH *Manual of diagnostic tests and vaccines for terrestrial animals* (Chapter 3.1.1). The strategies and policy guidelines are for emergency situations and are not applicable to policies for imported animals or animal products.

This manual has been produced in accordance with the procedures described in the **AUSVETPLAN *Overview***, and in consultation with Australian national, state and territory governments; the relevant livestock industries; nongovernment agencies; and public health authorities, where relevant.

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

1.2 Other documentation

This response strategy should be read and implemented in conjunction with:

- other AUSVETPLAN documents, including the operational, enterprise and management manuals; and any relevant guidance and resource documents. The complete series of manuals is available on the Animal Health Australia website[1]
- relevant nationally agreed standard operating procedures (NASOPs).[2] These procedures complement AUSVETPLAN and describe in detail specific actions undertaken during a response to an incident. NASOPs have been developed for use by jurisdictions during responses to emergency animal disease (EAD) incidents and emergencies
- relevant jurisdictional or industry policies, response plans, standard operating procedures and work instructions
- relevant Commonwealth and jurisdictional legislation and legal agreements (such as the Emergency Animal Disease Response Agreement – EADRA,[3]) where applicable.

1.3 Training resources

EAD preparedness and response arrangements in Australia

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

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

2 Nature of the disease

Anthrax is an infectious bacterial disease that can affect humans and a wide range of domestic and wild animals. The clinical forms of anthrax in animals are traditionally described as:

- **peracute** (very acute) – death occurs suddenly (within a few hours at most) of the onset of clinical signs
- **acute** – death occurs from 24 hours to a few days after onset
- **subacute or localised** – disease lasts for several days and might end in recovery
- **chronic** – recovered animals might show localised swelling and fever, but the only sign might be enlarged lymph glands.

In humans, anthrax classically causes three types of infection: pulmonary form (affecting the lungs), gastrointestinal form (affecting the digestive tract) and cutaneous form (affecting the skin).

2.1 Aetiology

Anthrax is caused by the bacterium *Bacillus anthracis* — a large, gram-positive, rod-shaped bacterium. *B. anthracis* produces a toxic complex comprising three factors: I (oedema factor), II (protective antigen) and III (lethal factor). Together, these factors kill phagocytes, damage capillary walls and interfere with blood clotting, leading to oedema, shock and death (Beveridge 1983). Protective antigen provides the mechanism for lethal factor to enter cells. An animal's production of an antibody against protective antigen protects it, at least partially, from infection.

Natural infection in animals usually occurs by ingestion of spores that can germinate in tissues such as the pharynx, mouth or intestines, or by absorption through the skin (contamination of pre-existing skin lesions) which can cause cutaneous infection.

Animals vary in their susceptibility to anthrax according to the route of infection. For most animals experimentally, the oral route is the least successful, and infection is most easily established by intramuscular injection. However, cattle are easily infected orally and more difficult to infect subcutaneously (de Vos 1994).

After the initial infection, the bacterium multiplies at the infection site. Bacteria then enter the bloodstream, where they are concentrated by the spleen and other lymphoid tissue until a point is reached when there is a sudden release of microorganisms and toxins back into the bloodstream, which leads to rapid death in ruminants. Valli (1985) stated that 'septicaemia in anthrax is a terminal event'. With dogs, pigs and horses, the toxins tend to kill the animal before bacteraemia reaches the level seen in ruminants.

2.2 Susceptible species

Anthrax affects many domestic and wild animals, and humans. The susceptibility of different animal species to anthrax varies considerably. Most warm-blooded vertebrate species (including reptiles and amphibians that have been artificially warmed) have been infected, naturally or experimentally. Herbivores are the most susceptible. Pigs, carnivores and ostriches are less susceptible, although outbreaks in these species do occur. In Australian species, cases of anthrax have been reported in dingoes and kangaroos in zoological gardens.

Cattle, sheep, goats and camelids

In cattle, sheep, goats and camelids, disease is usually peracute, and infected animals are often found dead before any signs of illness are observed (except perhaps in dairy animals that are under continuous and careful observation).

Pigs

In anthrax areas, pigs may be infected by feeding on carcasses or meat of cattle or sheep that have died from anthrax. Pigs manifest the subacute or the chronic forms of the disease. They have some degree of natural resistance and may recover. Pigs that recover from the disease may remain carriers of *B. anthracis*, but the role played by such a carrier state in the epidemiology of anthrax is uncertain.

Dogs, cats and horses

Dogs, cats and horses may also be infected, although cases are rare in Australia. Dogs have been infected in anthrax areas after being fed meat from infected carcasses. Horses suffer the acute form, whereas carnivores have some natural resistance and suffer the subacute or chronic forms, and may recover.

2.2.1 Zoonotic potential

Anthrax is a zoonosis.

2.3 World distribution

For the latest information on the distribution of Anthrax, refer to the World Organisation for Animal Health (WOAH) World Animal Health Information System.[5]

2.3.1 Distribution outside Australia

Anthrax probably originated in the Middle East and spread by trade in animals and animal products. It occurs nearly worldwide – on every continent except Antarctica – and only a few countries have never reported the disease (OIE 2020). Anthrax is acknowledged as being under-reported in many countries. It is still common in tropical Africa, the Middle East and neighbouring countries of the former Soviet Union, parts of central America and South America, and parts of Asia.

In countries where the disease is not well controlled, regular outbreaks of anthrax can become serious epidemics of both animals and humans. For example, when civil war interrupted normal vaccination and regulatory controls in Zimbabwe in the late 1970s, a massive outbreak resulted in more than 10 000 human cases and untold numbers of cattle deaths (de Vos 1994).

In countries with well-established veterinary services and public health monitoring (eg Europe, North America, northern Asia, Australia), anthrax outbreaks are rapidly contained by the imposition of standard control measures. Such outbreaks can affect both domestic animals (Fox et al 1973) and wildlife (de Vos 1994, Dragon & Rennie 1995). Human cases do not occur in significant numbers in areas where there is effective carcass control.

[5] https://wahis.oie.int/#/home

An increasing number of countries have been free from anthrax for a considerable time – New Zealand (since 1954), Cyprus (1969), Ireland (1970), Malta (1974) and Sweden (1981) (OIE 2011).

Anthrax occurred in New Zealand in the late 1800s and early 1900s, and was associated with the importation of meat and bonemeal fertiliser. Between 1903 and 1932, a series of measures was put in place to prevent the introduction of anthrax, including a ban on the importation of meat and bonemeal. New Zealand has been considered to be free from anthrax since 1954 (OIE 2011), when a suspected outbreak occurred (although there is some uncertainty about whether this case was ever confirmed).

In Cyprus, anthrax was formerly one of the most serious diseases of sheep and goats. Human infection was common in the early 1900s. Fortunately, the disease has declined steadily since 1950. This has been attributed to the systematic, compulsory vaccination of sheep and goats on the island. Vaccination ceased in some areas after 1968 and completely stopped in 1975 (Economides 2000).

2.3.2 Occurrence in Australia

Historical occurrence in Australia

Animals

Anthrax was introduced into Australia in 1847 near Sydney, and spread along stock routes throughout New South Wales and southern Queensland. It was introduced into Victoria in 1876, and occasional outbreaks were also seen in South Australia and Tasmania (Seddon 1965). Routine quarantine with vaccination on and around infected premises (IPs) was adopted in the 1890s and, with regulatory controls, has been very successful in limiting the disease. Until 1997, anthrax occurred only as 'sporadic incidents'; there had been no cases of the disease in Victoria since 1988, and no recorded instances of the disease in the Goulburn Valley in central northern Victoria since 1914.

From 26 January to 26 March 1997, there was an 'unusual outbreak' in the Tatura–Stanhope area of the Goulburn Valley, which led to the deaths of 202 cattle and 4 sheep on 83 farms. The control program involved vaccination of 78 649 cattle from 539 herds. The epidemic curve returned to its baseline on 26 February 1997. Concurrent with this event, a single sporadic incident occurred in a single cow in central northern Victoria, outside the usual outbreak area. The infected herd and 49 surrounding herds were subsequently vaccinated, and no further cases occurred on other properties in this area.

In the summer of 1997–98, six anthrax cases occurred on the previously infected properties in central northern Victoria. All six cases were in young stock that had been vaccinated only once. In the summers of 1998–99, 1999–2000 and 2000–01, there were no cases of anthrax in Victoria, despite extensive monitoring for the disease. Subsequently, in autumn 2002, there was a single case on each of two separate properties that had had cases in January–March 1997.

A second unusual outbreak occurred in the Tatura–Stanhope area of the Goulburn Valley in 2007, involving 10 properties. There were three foci of infection with no apparent link. As a precaution against the development of a larger outbreak, 35 183 cattle and 1024 sheep were vaccinated on properties in the area that had a history of anthrax.

Only sporadic incidents occurred in New South Wales from 1997 to 2002, with the highest incidence being six cases in 1997–98.

There has been no evidence of anthrax in South Australia or Tasmania since the last reported cases in 1914 and 1933, respectively. These states are now considered free from the disease. No cases have ever been reported in the Northern Territory, which is also considered free from the disease.

Western Australia was free from the disease until 1994, when cases occurred on three premises in a localised area. No further cases have occurred in Western Australia.

There had been no cases in Queensland for more than 70 years until one infected animal was detected on a single farm in 1993. This occurred in an area geographically distant from the areas of historical outbreaks and was apparently due to contaminated feed. In 2002, anthrax occurred on a property in southern Queensland near the New South Wales border. Cattle that were moved from the index property to another property about 400 km north later developed cases of anthrax.

Humans

Only the cutaneous form of anthrax has been reported in humans in Australia; pulmonary and intestinal forms have never been reported. In the 1920s and 1930s, cutaneous cases were associated with infected shaving-brush bristles. A number of people died from this source of infection, since there were no antibiotics available at that time. In the early 1960s, a farm worker in New South Wales contracted cutaneous anthrax after conducting postmortem examinations on dead sheep. The worker refused early medical treatment and died from the disease.

Human cases have become less common over time, reflecting the reductions in animal cases, as well as greater awareness of modes of transmission and infection control precautions. Six human cases were reported from 1977 to 1987, two from 1988 to 1998, and three since 2002 (in 2006, 2007 and 2010). The recent human cases have resulted from close contact with infected animal carcasses or machinery that had been used on infected land.

Anthrax in humans has been nationally notifiable only since 1 January 2001.

Current situation in animals in Australia

Anthrax continues to be uncommon in Australia, and clinical cases of the disease are seen only sporadically. Most cases occur in sheep, with some in cattle and a few in pigs. Goats and horses are rarely affected. The areas where cases occur tend to have neutral to alkaline subsoil and to be on floodplains along waterways, although cases may occur away from waterways on acidic soils. Each year, cases occur on only 6–12 premises (on average) in all of Australia. Usually, only a small number of cases occurs on each affected farm (eg average of 1–3 cattle or 5–20 sheep).

Sporadic cases are reported through the centre of New South Wales, and into northern and northeastern Victoria. The affected areas of New South Wales are largely sheep-raising areas with an annual rainfall of 250–500 millimetres, and cases occur predominantly between October and March. In Victoria, almost all incidents and outbreaks occur in cattle. Past cases have occurred relatively evenly throughout the year in Victoria; however, in recent years, cases have tended to occur in summer and autumn.

Western Australia has only recorded cases in a localised, isolated area in the southwest of the state, north of Albany. The remainder of Western Australia is considered to be free from anthrax.

Two properties in southern Queensland linked by cattle movements suffered cases in 2002. The remainder of Queensland is still considered to be free from anthrax.

The Northern Territory, South Australia and Tasmania are considered to be free from anthrax.

For the latest information on the global distribution of anthrax, refer to the website of the World Animal Health Information Database (WAHID)[6] of the World Organisation for Animal Health (OIE).

[6] www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home

2.4 Epidemiology

2.4.1 Incubation period

Herbivores exposed to infection develop clinical signs within 4–10 days.

Animals incubating anthrax have the bacteria continuously filtered out of the bloodstream by the spleen and lymph nodes until the last few hours of life, when the bacteria rapidly build up in the bloodstream to cause a terminal septicaemia only hours before death (Valli 1985).

WOAH incubation/infective period

For the purposes of the WOAH *Terrestrial animal health code,* the incubation or infective period[7] for Anthrax is 20 days.

2.4.2 Persistence of agent and modes of transmission

Anthrax is unusual among animal diseases in that it is not contagious – that is, spread between live animals is insignificant. It is spread by release of bacterial spores from the carcass of an animal that has died from the disease and the subsequent ingestion of these spores by other animals. The period during which infection is systemic is short, and the risk of spread of infection by preclinical infected animals is low.

However, in an unusual outbreak, common factors may exist on properties that are potentially IPs in an area (other than the confirmed IPs) that expose animals to infection with anthrax spores. These factors include previous cases of infection (possibly decades earlier), soil type, climatic conditions, topography, drainage systems and stocking density. An unusual outbreak can also arise if a contaminated product, such as inadequately processed blood-and-bone fertiliser, is applied to several properties in a short period.

General properties

In its vegetative form, *B. anthracis* is fragile and easily inactivated by disinfectants or exposure to moderate temperatures. It is also destroyed by normal postmortem changes. However, on exposure to air, it forms highly resistant spores that can remain viable for many years in some soils. The spores are much more temperature resistant than the vegetative form, but not as resistant as the spores of most clostridia and other *Bacillus* species.

Vegetative *B. anthracis* cannot survive long in the environment and, when released from a carcass, has to sporulate or die. The conditions necessary for sporulation are:

- the release of vegetative bacteria from the carcass at death
- a minimum temperature of 22 °C
- a medium that is nutrient and oxygen rich, such as blood.

[7] In the OIE Terrestrial animal health code, 'incubation period' means the longest period that elapses between the introduction of the pathogenic agent into the animal and the occurrence of the first clinical signs of the disease (see www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=glossaire.htm).

In environments such as water or milk, the vegetative organism dies spontaneously; it is not able to sporulate in these media (Minett 1950, Turnbull et al 1991, Bowen & Turnbull 1992, Lindeque & Turnbull 1994). Ordinary antiseptics or heat can readily destroy the vegetative organism (see below), and diluting infected materials in water and reducing temperatures to below 22 °C can prevent the bacteria from sporulating.

The effect of heat treatment depends on the type of heat and whether the organism is in its vegetative or spore form. The vegetative form is killed by heating to 58 °C for 15 minutes. The spore form is quite resistant to dry heat, and requires a temperature of 140 °C for 3 hours for destruction. Under moist conditions, the spores are destroyed by a temperature of 100–115 °C for 15 minutes (de Vos 1994) or 100–105 °C for 20 minutes (Gracey & Collins 1992).

Environment (including windborne spread)

Although the anthrax spore is much more resistant to the environment than the vegetative organism, it is not virtually indestructible, as was once thought. However, spores deposited below the upper soil levels (below 15 cm) can remain viable for long periods, even centuries, in a favourable environment (de Vos 1998). In two cases, anthrax outbreaks started from spillage at old knackery and tannery sites, where spores had been washed into the soil below, and were then brought to the surface decades later by deep ploughing. Subsoils that are pH 9 and calcareous in nature are the most favourable for the survival of spores. Soils with a pH higher than 9 are unfavourable to spore survival.

Spores on and just below the soil surface are subject to wind, rain, sunlight (including ultraviolet light), acidity, dryness and the activities of other microorganisms, and these factors all have a significant impact on spore viability (Lindeque & Turnbull 1994, Dragon & Rennie 1995). It is increasingly accepted that spore numbers on the surface at infected sites diminish with time, so that infective capacity can be lost over about 3 years if there is no replenishment.

There is debate about whether *B. anthracis* spores can germinate and multiply in the environment. Clear scientific evidence is not readily available. However, the conditions under which multiplication could take place in the environment probably only occur in exceptional circumstances (WHO 2008).

A review of the effectiveness of various chemical and physical agents in the inactivation of anthrax spores is available (Whitney et al 2003).

Live animals

Natural infection in animals occurs by ingestion of spores. Infection is not usually spread between live animals.

Animals incubating the disease are not infectious for other animals until they die and bloody discharges from the orifices spill bacteria or spores into the environment. Susceptible animals contract infection from exudates from the dead animal or from the site on which it died. The high concentration of organisms in ruminants' blood at death ensures high spore concentrations at death sites, particularly if carcasses are broken open. The curiosity of cohort animals, which causes sniffing and licking of carcasses and grazing of infected sites, leads to their infection.

Pigs and carnivores have acquired infection from inadvertent feeding of anthrax-affected carcasses and offal (WHO 2008). In Australia, herbivores acquire infection only from pasture sources.

Anthrax does not form a carrier state in susceptible animals (except possibly in pigs). Infection can only be spread to another site if live animals in the incubation phase of the disease are moved, and then die and release bacteria or spores at the new site. As a precaution, animals can be moved to a

holding site that is not contaminated for 20 days, with or without vaccination. If no disease occurs, infection will not be transferred with the animals.

In the past, travelling stock were a significant means of spread of anthrax across Australia and contamination of stock routes. Anthrax is now rarely recorded as being spread by movement of infected incubating animals between premises. Vaccination, movement restrictions and tracing now control such spread.

Carcasses

Ruminants that die from anthrax have high levels of *B. anthracis* in the carcass and offal. The vegetative organisms in carcasses that are left intact die out over a period of 3 days at temperatures of 25 °C or higher. The death site remains contaminated with organisms spilling from the carcass and sporulating, unless the site is decontaminated, either manually or naturally (see 'General properties', above).

Vegetative bacteria have been grown from spores that have been in a favourable subsoil environment for around 200 years (de Vos 1998). Therefore, spores associated with an infected carcass buried in a favourable subsoil environment (pH 9, calcareous) provide a source of sufficient concentration to initiate infection in future seasons and years.

Formaldehyde prevents scavenging of carcasses and avoids further contamination of the environment (ProMed-mail 2010).

Nonruminant carcasses do not play a significant part in the spread of anthrax, and few infections occur in these species. These species all have low levels of septicaemia compared with ruminants and so have little potential to contaminate the environment.

Animal products

Products from animals that have died from anthrax can transmit infection if there has been inadequate heat treatment to destroy spores or vegetative organisms.

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

Under Australian field conditions, anthrax pathogenesis involves the bacteria being continuously filtered out of the host's bloodstream until the last few hours of life, when the bacteria rapidly build up in the bloodstream. Thus, the carcases of infected animals have septicaemic characteristics that make them unsuitable for meat.

Meat and meat products from animals that have died from anthrax can spread the disease to animals and humans that eat untreated or insufficiently treated products. Humans handling such products can contract cutaneous anthrax.

Vegetative bacilli are destroyed by heating at 58 °C for 15 minutes, and both spores and vegetative bacilli are destroyed by moist heat at 100–115 °C for 15 minutes (de Vos 1994) or 100–105 °C for 20 minutes (Gracey & Collins 1992). *B. anthracis* spores cannot germinate and grow in meatmeal (unlike *Salmonella* species).

Traditionally, meatmeal and bonemeal prepared from animals that have died from anthrax were a significant means of spreading anthrax, but adequate processing standards have eliminated this means of transferring infection. The prohibition on feeding meatmeal and bonemeal to ruminants ensures that these products are not involved in the spread of anthrax in Australia.

Milk and dairy products, including use as animal feed

Anthrax bacilli can be detected in cows' milk only at the point of, and after, death (M'Fadyean 1909). Bowen and Turnbull (1992) found that vegetative bacilli die out in milk over a period of 24 hours at 5–9 °C, and faster at higher temperatures. Pasteurisation destroys vegetative bacteria. Thus, anthrax vegetative bacilli cannot survive in milk, nor can they sporulate in unpasteurised milk.

There are no records in the scientific literature of anthrax being transmitted to humans through the consumption of milk or dairy products (M'Fadyean 1909, Steele & Helvig 1953, WHO 2008). Heymann (2008) states that there is no evidence that milk from infected animals transmits anthrax.

The World Health Organization (WHO) guidelines for surveillance and control of anthrax in humans and animals (WHO 2008) recognise that the destruction of large quantities of milk is wasteful.

Farmers, owners and public health authorities can reduce the already minimal risk of transmission via milk by:

- milking only healthy animals – animals showing signs of illness should be set aside for appropriate treatment, and the milk from these animals and utensils used in its collection should be sterilised
- ensuring that hygienic practices are in place to prevent contamination of the environment with anthrax spores and prevent contamination of milk from the environment
- ensuring that all milk is rapidly cooled to 4 °C within 4 hours of milking, and is held at this temperature until processed at a licensed dairy plant
- ensuring that all milk is pasteurised before processing, whether for animal or human consumption.

Animal byproducts

Hides, skin, wool and other fibres

Hides and skins

Historically, hides and skins collected from animals that have died from anthrax have led to human infections associated with tanneries. Effluent from tanneries handling infected skins and hides can be a source of infection for grazing animals when it is discharged to pasture (WHO 2008). Untanned hides and skins require an import permit for entry into Australia and are subject to tanning at quarantine-approved premises that have appropriate measures in place for the disposal of effluent.

Wool and hair

Historically, the collection of wool and hair from animals that have died from anthrax has been recorded as leading to human infection in both the cutaneous and pulmonary forms. The introduction of hair into woollen mills led to pulmonary anthrax ('woolsorters' disease') in the mills. Hair allows the spores to more easily become aerosolised and provide infectious doses to mill workers (Laforce 1978). Wool and hair products can be disinfected by using chemical or irradiation treatments (WHO 2008).

Effluent from scouring plants is able to transmit infection to pastures and to susceptible ruminants.

Australian wool and hair have not been recorded as causing anthrax infection in humans in woollen mills or other wool handling centres. Woolsorters' disease has not been recorded in Australian woollen mills.

Note: In Australia, wool and hair are no longer plucked from carcasses. To reduce the risk of contamination with *B. anthracis* to an acceptable level, imported animal hair and wool, on entry to Australia, may be subject to:

- scouring
- a dyeing process or other equivalent treatment process
- gamma irradiation[8]
- re-export
- destruction.

The treatment applied will depend on the country of origin, the commodity type, any prior treatments, and whether faecal contamination is detected. Imported wool and hair requiring treatment will have such measures conducted at quarantine-approved premises that have appropriate measures in place for the disposal of effluent.

Equipment, including personal items

The role of personnel, equipment, protective clothing and other fomites that are not directly exposed to infected animals or infected sites in transmitting infection is not clear. Equipment used in handling infected stock could spread infection to susceptible stock or humans, either through broken skin or by injection, if the equipment is not sterilised before reuse.

Vectors

B. anthracis may be transmitted mechanically by insect vectors, including flies, mosquitoes and ticks.

Tabanid flies have been recorded as being able to spread anthrax mechanically from incubating animals to susceptible animals. In the 1997 Australian outbreak, domestic and bush flies were shown to carry *B. anthracis* after feeding on carcasses of animals that had died from anthrax, but their role in the spread of disease is unclear.

Blowflies, however, play an important role in the transmission of anthrax because their feeding and postfeeding habits (disgorging ingested carcass material on surfaces) provide a link between the carcass and its environment. In addition, blowflies can disperse over significant distances from carcasses (de Vos 1994). In South Africa, bush flies have been noted to regurgitate carcass feedings in trees; browsing wildlife that feed on the trees can contract anthrax.

Although other insects, such as mosquitoes, can transmit infection, it would probably take numerous bites and uninterrupted feedings by many insects to transmit the disease (de Vos 1994).

The role of crows or foxes in the dissemination of anthrax is not entirely clear. Scavenging animals, including hyenas and vultures in Kruger National Park, South Africa, are credited with spreading infection, particularly through congregating at watering holes, dragging pieces of infected carcass around death sites and defecating infected material (de Vos 1994). In Canada, formaldehyde is used to actively discourage scavenging of bison carcasses by wolves, foxes and bears, to prevent significant contamination of the surrounding area (ProMed-mail 2010).

[8] For information, refer to the Australian Government Department of Agriculture, Water and the Environment

2.4.3 Factors influencing transmission

Environmental conditions favouring outbreaks vary widely between locations.

The important traditional means for spread of anthrax to herbivores was through eating contaminated, improperly treated meatmeal, and contact with dead animals or the contamination left at their death or burial site.

Since feeding meatmeal to ruminants is now prohibited in Australia, the most important means by which anthrax is spread to herbivores is by eating pasture on or around a former death site, or sniffing and licking around a recent anthrax carcass. Transport of incubating infected animals can transfer infection across paddocks, properties and districts.

Disturbance of soil by flood damage or ploughing may expose previously buried spores.

There is little doubt that anthrax incidence is related to temperature and rainfall. Anecdotal reports suggest that anthrax cases are sometimes observed after moderate rainfall following prolonged dry periods. Climate can influence the way in which an animal comes into contact with the spores (eg animals graze closer to the soil in dry periods when grass is short or sparse; herds may be moved to contaminated sites when water becomes scarce). The spores, which can float, may be concentrated in sunken areas following heavy rain. Their exposure tends to occur after a long dry period that reduces vegetative cover.

Climate can also affect the general health of the host and its resistance to infection (WHO 2008).

Alkaline soils favour the survival of spores, and anthrax tends to persist in areas of Australia where these soils occur.

The source of infection for many incidents is often unknown. One clear source is the deep ploughing of pastures previously contaminated with effluent from knackeries or tanneries, or the unearthing of old graves (eg by flooding). Once an animal has been infected and dies, spores originating from its carcass remain a potential source of infection.

The WHO guidelines (WHO 2008) state the following:

- The extent to which they [spores] may then germinate, multiply as vegetative bacilli and resporulate, setting up subsidiary cycles in the environment, remains a topic of debate.
- While it has been shown that environmental cycling can be induced experimentally, the level of nutrient required for this to become possible is probably not reached very frequently under natural conditions. If the spores germinate, the emergent vegetative cells might generally be expected to die spontaneously or as a result of competition from soil microflora, or both.

2.5 Diagnostic criteria

2.5.1 Clinical signs

During the incubation period, the bacteria multiply at the site of infection and are concentrated by the spleen and other lymphoid tissue until the immune system is overwhelmed. The subsequent sudden release of organisms and toxins into the bloodstream leads to rapid death in ruminants. In infected dogs, pigs and horses, bacterial toxins tend to kill the animal before the levels of bacteria reach those

associated with death in ruminants (see Section 2.6). Carcasses may be found near water, as animals have a fever before death.

Animals

Grazing animals

Usually, the first indication that grazing animals might have anthrax is when they are found dead in the paddock. Blood-stained discharges at external orifices are characteristic of the disease, but not all anthrax cases show these signs. A reliable sign is the failure of blood to clot. This is seen when samples are collected from carcasses for diagnostic examination, or if the carcass has been attacked by predators. Dairy cattle may show a change in temperament and a drop in milk production. Horses usually suffer a sudden death, with oedema of the chest, abdomen and limbs; some horses may survive for days with colic and oedema.

Pigs

Pigs are usually visibly ill, with fevers of up to 42 °C (commonly above 41 °C), dullness, anorexia, swelling of the neck and face, and sometimes bloodstained froth at the mouth. In the localised pharyngeal form, swelling around the pharynx restricts respiration, causing laboured breathing and cyanosis of mucous membranes. Death can occur as soon as 12–18 hours after clinical signs develop, probably due to asphyxiation, but infected pigs commonly die after 2–7 days. Sudden death due to infection of the blood (septicaemia) may occur in young pigs. Anthrax bacilli localise in the lungs, causing respiratory signs and bloodstained froth from the mouth. In the intestinal form of anthrax, there may be either dysentery or constipation, or one followed by the other, and blood-stained froth from the mouth.

Dogs and cats

Dogs and cats, as carnivores, are generally highly resistant to anthrax. Ingestion of large numbers of anthrax bacilli in infected meat is necessary to establish infection. Dogs and cats often recover without treatment, although 100 cats died after eating meat from anthrax-affected cattle at Dubbo in 1885 (New South Wales Anthrax Board 1889). In dogs, high temperature and sudden death with swollen throat lymph nodes are usually seen.

Humans

In humans, anthrax classically causes one of three types of infection: lung (pulmonary form), digestive tract (gastrointestinal form) or skin (cutaneous form). More than 95% of naturally acquired cases worldwide are of the cutaneous form, and this is the only type that has ever been recorded in Australia. Cases in Australia have usually been associated with an occupational activity.

Cutaneous infections follow contamination of a pre-existing skin lesion and therefore are mostly seen on exposed areas of the body (eg hands, arms, neck, face). Anthrax skin infections usually commence with itchiness, followed by a skin lesion that progresses through several stages:

- a papular stage
- a vesicle stage (a surrounding collar of vesicles that may become haemorrhagic)
- an eschar stage – after 2–6 days, a depressed black lesion (malignant pustule) develops, surrounded by extensive, often severe oedema. This swelling tends to be disproportionately greater than would be expected for the size of the lesion and results from the effects of the oedema toxin. Lesions close to the neck may be complicated by significant swelling, which may threaten airways and necessitate intubation.

Anthrax lesions are usually painless unless there is pain due to secondary infection or the surrounding oedema. Untreated lesions can progress to involve the regional lymph nodes. In severe cases, an overwhelming septicaemia or meningitis can occur.

2.5.2 Pathology

Gross lesions

In the unopened animal carcass, anthrax bacilli do not sporulate and are destroyed by the putrefactive process of postmortem change. Thus, to prevent spore formation and unnecessary contamination of the environment, postmortem examination of suspected cases of anthrax is actively discouraged.

If a carcass of an animal that has died from anthrax is opened, dark, unclotted blood and an enlarged, haemorrhagic spleen are immediate indicators of anthrax (de Vos 1994). However, an enlarged spleen (splenomegaly), cited as a characteristic feature of anthrax and regularly seen in cattle, is uncommon in sheep, pigs and horses. The mesentery may be thickened and oedematous, with excess peritoneal, pleural and pericardial fluid. Petechial haemorrhages may be visible in many organs, and the intestinal mucosa may be dark red and oedematous, with some areas of necrosis. In many cases, rigor mortis does not occur. However, not all the signs are uniformly present in all cases of anthrax.

If a postmortem examination is conducted and anthrax is confirmed, the carcass and all disposable equipment should be destroyed as quickly as possible and the immediate area disinfected. Staff handling such cases should seek medical advice (see Section 4.2).

2.5.3 Differential diagnosis

Anthrax should be considered in the differential diagnosis of all cases of sudden death in grazing animals, especially when bloodstained exudate is present at the nose, mouth or anus. Anthrax cases are most often misdiagnosed as clostridial diseases, such as:

- blackleg (*Clostridium chauvoei*)
- black disease (*Clostridium novyi*)
- malignant oedema (*Clostridium septicum*)
- enterotoxaemia (*Clostridium perfringens* type D).

Less likely misdiagnoses include metabolic diseases such as grass tetany or milk fever.

Important factors in diagnosis include:

- the anthrax history of the area
- the vaccination status of the stock (for anthrax and clostridial diseases, in particular)
- whether a full vaccination course was administered
- whether antibiotics were given near the time of vaccination
- the possibility that infected animals or anthrax spores may have been introduced from other areas or spread from other cases.

2.5.4 Laboratory tests

Veterinary laboratories with adequate biocontainment can undertake detection of encapsulated *B. anthracis* in infected blood or tissues, and growth of the organism on blood agar plates.

Samples required

If a veterinarian suspects that an animal has died from anthrax, they should collect blood from the peripheral vessels using a vacuum tube. This blood should be submitted to a veterinary laboratory for microscopic examination of blood smears and bacterial culture. Where appropriate, air-dried blood smears may be forwarded to the laboratory.

If blood samples cannot be collected, oedematous fluid or exudate could be collected in a vacuum tube for diagnostic purposes. A piece of tissue (eg the ear from the dependent side, in which blood will collect) could also be collected in a secure, double plastic bag.

Sharps (needles or blades) must **not**, under any circumstances, be forwarded with the samples; they must be disposed of in an appropriate container.

Transport of specimens

Specimens should be submitted in accordance with agreed state or territory protocols.

For further information, see the **AUSVETPLAN management manual *Laboratory preparedness***.

Packing specimens for transport

All diagnostic specimens must be placed securely in a primary container that is enclosed within a secondary container. This is to prevent any leakage from broken blood tubes or glass slides in transit. A frozen gel pack should be used to maintain samples in the best possible condition during transport. Because anthrax is a human pathogen, it is essential that all statutory requirements are met for the transport of specimens. Specimens should be packed and labelled in compliance with the carrier's conditions, government and postal regulations, and International Air Transport Association regulations, as appropriate. The laboratory should be advised in advance that suspect anthrax samples are being sent to them, and the specimen advice form should be clearly marked that it is for anthrax diagnosis.

2.5.5 Laboratory diagnosis

Examination of blood smears

Virulent, encapsulated *B. anthracis* is present in tissues and other body fluids from animals that have died from anthrax. These capsules can be visualised in a thin smear of blood or tissue fluid that has been stained with aged polychrome methylene blue. The capsule stains pink and surrounds the dark-blue bacillus rod. The bacteria are found in pairs or short chains, often with square ends. The pink capsule distinguishes them from clostridia. However, as the time after death increases, the ability to visualise the stained capsule decreases.

***Culture and identification of* B. anthracis**

The gold standard for diagnosis of anthrax is culture and subsequent identification of the organism using culture morphology, Gram stain, lack of motility and biochemical tests. *B. anthracis* should be cultured under physical containment level 3 (PC3) conditions. Sheep blood agar is routinely used for culture; after overnight incubation at 37 °C, characteristic colonies are nonhaemolytic or weakly haemolytic, white or grey–white in colour, relatively large and matt, with a rough ground-glass appearance and a tacky consistency, forming peaks like beaten egg whites when sampled with a bacterial loop.

For older diagnostic specimens or contaminated samples, culture on *B. anthracis* selective media is necessary – PLET (polymyxin B, lysozyme, EDTA, thallous) agar is preferred. Colonies are usually smaller when grown on this media than when grown on sheep blood agar.

When a positive culture of *B. anthracis* is obtained, the laboratory should notify the national reference laboratory for anthrax (Anthrax Reference Laboratory),[9] and submit culture samples for the national reference collection of *B. anthracis*. The Anthrax Reference Laboratory will perform further genomic characterisation of the isolate to assist in molecular epidemiological studies.

Polymerase chain reaction

Polymerase chain reaction (PCR) assays are available with specific primers for detection of *B. anthracis*, including the EMAI PCR (PCR developed by the Elizabeth Macarthur Agricultural Institute) for use on dried blood-smear preparations and the WHO/OIE-plasmid PCR (developed by WHO and the OIE). Many real-time PCR tests have been published that target the plasmids and, more recently, chromosomal regions of *B. anthracis*. PCR is a useful laboratory tool for detection of *B. anthracis* in blood-smear scrapings, blood, tissues and bacterial cultures (Berg et al 2006).

Immunochromatographic antigen detection assay

An approved hand-held immunochromatographic test (ICT) assay for diagnosis of *B. anthracis* in the field is available from the Anthrax Reference Laboratory. This test detects the protective antigen expressed in the bloodstream of an animal, and is an excellent screening test (Muller et al 2004). Only blood samples collected within 48 hours after death should be tested. The ICT can be read within 15 minutes, requires very basic training in its use and can be performed at point-of-care (Burans et al 1995). Positive results should be confirmed, for at least the first case on a premises, at an approved laboratory and subsequently provided to the Anthrax Reference Laboratory.

Tests (laboratory and field) that are currently available are shown in Table 2.1.

Table 2.1 Laboratory tests currently available for the diagnosis of anthrax

Test	Specimen required	Test detects	Time taken to obtain result
Agent detection			
Blood smears	Blood	Organism	15 minutes
Bacterial culture	Blood, fluids, tissue	Organism	1–2 days
ICT (point-of-care test)	Blood	Bacterial antigen	15 minutes
PCR (multiplex)	Blood, blood smears, tissue, cultured bacteria	Bacterial DNA	6–8 hours
Real-time PCR	Blood, tissue, cultured bacteria	Bacterial DNA	6 hours
Agent characterisation			
PCR (pathogenicity factors)	Bacterial DNA	PX01, PX02	6–8 hours
SNP analysis	Bacterial DNA	Strain type	3–5 days

[9] Anthrax Reference Laboratory, AgriBio, Centre for AgriBioscience, 5 Ring Road, La Trobe University, Bundoora, Vic 3083, telephone: 03 9032 7000

Test	Specimen required	Test detects	Time taken to obtain result
MLVA/SNR analysis	Bacterial DNA	Strain type	5–10 days

ICT = immunochromatographic test; MLVA = multilocus variable-number-tandem-repeat analysis; PCR = polymerase chain reaction; SNP = single nucleotide polymorphism; SNR = single nucleotide repeat
Source: various sources, 2010 (refer to the Anthrax Reference Laboratory for the most up-to-date information)

CSIRO-ACDP tests

Not relevant.

2.6 Resistance and immunity

Innate immunity

Susceptibility of animals to natural infection does not correlate with susceptibility to experimental infection, and varies with the route of exposure. When tested experimentally, cattle, horses and donkeys appear to have a greater degree of natural resistance to anthrax than sheep and goats. However, under natural conditions, the former species appear to be more commonly infected than the latter (de Vos 1994).

Innate resistance to anthrax appears to depend on inhibition of the initial spore germination or bacterial multiplication. Carnivores, rats and chickens appear to have a high resistance to infection but, once infected, are highly susceptible to the effects of the toxins – as infection progresses, they develop a low-level bacteraemia in the terminal septicaemia. In contrast, herbivores (including guinea pigs and rabbits) have a much lower resistance to infection and a relatively high resistance to the toxins, so they develop a high-level bacteraemia in the terminal septicaemia (de Vos 1994).

Acquired immunity

Although the mortality rate is high, animals surviving naturally acquired anthrax are immune to reinfection. Second attacks are extremely rare.

2.7 Vaccination

In the early 1890s, a double-dose Pasteur vaccine was used. From the late 1890s to 1960, this was replaced by a single-dose attenuated spore vaccine developed by Gunn and McGarvie Smith. Since 1960, all vaccines used in Australia have contained living spores of the noncapsulated, naturally avirulent (live) Sterne 34F2 strain of *B. anthracis*.

Australia used anthrax vaccines so infrequently each year during the 1990s that only one Australian manufacturer produced the Sterne 34F2 strain vaccine. This manufacturer ceased producing anthrax vaccine in late 1996. Australia currently imports anthrax vaccine from an overseas manufacturer because of continuing low annual use. The vaccine is registered through the Australian Pesticides and Veterinary Medicines Authority.

All people handling live vaccines should wear appropriate personal protective equipment (see Section 4.3.11 on decontamination procedures for personnel, clothing and equipment).

The currently registered vaccine delivers the following minimum doses:

- cattle – 1 mL dose containing 4 million viable spores
- sheep and goats – 0.5 mL dose containing 2 million viable spores.

(Note: the spore count specified for vaccine manufacturers in the United States is 2 million viable spores per dose.)

In the areas of Australia where anthrax occurs sporadically, preventive vaccination is undertaken annually on a small proportion of previously affected properties.

A single vaccination is usually effective for 6–12 months, provided that animals receive the full dose and are not treated with antibiotics within 10–14 days before or after vaccination. The Sterne 34F2 strain vaccine causes few adverse reactions in cattle and sheep. There may be an elevated temperature 12–36 hours after vaccination, causing reduced milk yield and possibly abortion in dairy cows. However, severe reactions can occur in goats, alpacas and horses. Hence, enforcing vaccination in these species needs careful consideration. Care always needs to be taken when vaccinating animals in hot weather.

Animals that have been vaccinated twice, at least 6 months apart, are probably immune for life. Vaccine manufacturers' advice on immunity is that it will peak at 15 days after the first vaccination. In the Victorian outbreak in 1997, 0.15% of vaccinated animals died more than 15 days after vaccination. These deaths were attributed to an inadequate dose of vaccine, an inadequate immune response to a correct dose of vaccine, or a high-challenge dose overwhelming an established but otherwise adequate immunity. There was also the possibility of interference from antibiotic treatment for conditions such as footrot and mastitis (Turner et al 1999ab).

Vaccinating exposed animals on infected premises (IPs) following an incident provides time for spores on the soil surface to be dispersed and inactivated to levels that are unlikely to support initiation of infection. Vaccination does not seem to halt deaths as efficiently in an outbreak setting as in sporadic incidents, when deaths normally cease 5–7 days after vaccination. Deaths will continue on heavily contaminated premises for more than 10 days after vaccination (up to 60 days has been recorded), and there may be pressure from livestock owners to carry out revaccination. Whether revaccination is beneficial is unclear, although there is probably little benefit in revaccinating less than 6 months after the first vaccination.

Feedlots, as enterprises with large aggregates of animals, need to have a policy on whether to routinely require prior vaccination of all entering animals, vaccinate all animals on arrival, vaccinate animals from certain areas, or not vaccinate at all. Anthrax vaccination is not warranted at all feedlots. Feedlot managers should conduct their own risk assessment for their situation and decide whether vaccine will be applied to all, some or no animals entering the feedlot. Feedlot managers may require vaccination of animals from certain regions weeks in advance of arrival. The *National biosecurity manual for beef cattle feedlots*[10] contains information on managing anthrax in feedlot situations.

Vaccination and withholding periods

Cows vaccinated with the Sterne 34F2 strain vaccine do not shed *B. anthracis* in their milk (Tanner et al 1978). Neither the United States Department of Agriculture nor the Australian Pesticides and Veterinary Medicines Authority, which registers agricultural and veterinary chemicals, imposes a

[10] www.farmbiosecurity.com.au/wp-content/uploads/2019/03/National-Biosecurity-Manual-for-Beef-Cattle-Feedlots1.pdf

withholding period for milk from vaccinated cattle. Australian milk and dairy products have never been shown to cause anthrax in humans or calves.

Australia requires a 42-day withholding period for meat after anthrax vaccination. This is consistent with the requirements of the United States Department of Agriculture and the WHO guidelines (WHO 2008).

Penalties apply for unauthorised disposal or slaughter of stock within the vaccine's meat withholding period under both disease control legislation and legislation controlling the use of veterinary chemicals. Careful consideration should be given to the meat withholding period before vaccinating livestock, particularly in feedlots.

2.8 Treatment of infected animals

Mass herd treatment with antibiotics has been carried out with variable results. The Australian experience does not support the wholesale treatment with antibiotics of animals exposed to anthrax infection because:

- a single treatment without a suspicion of infection (such as clinical signs or elevated temperature) will not necessarily protect against infection
- treatment with antibiotics prevents effective vaccination of animals for a variable period (more than 10 days)
- it is critical to raise herd immunity to minimise dissemination of the disease following exposure to further cases in the herd
- the withholding periods of antibiotics applicable for animal products, such as milk, impose a large financial burden on producers.

Antibiotic treatment of valuable infected animals that have temperatures higher than 40 °C may allow complete recovery if given early in the course of the disease. Where it is likely that a herd has been exposed to a high level of anthrax and that multiple deaths will occur before immunity from vaccination has developed, use of antibiotics to prevent deaths may be considered. In such circumstances, the livestock must be removed from the high-risk areas of the property and vaccinated after the 10-day period has expired.

3 Implications for Australia

3.1 Potential pathways of introduction

Current quarantine restrictions on the entry of animals, and animal products and byproducts provide little opportunity for further introductions of anthrax spores in sufficient numbers to establish infection in Australia.

One route by which infection could be introduced is through animal remedies containing animal extracts not declared as ingredients, if the material was not processed to eliminate anthrax contamination. This was a suspicious source for one case of anthrax in an otherwise anthrax-free area. Another possible source of infection is the import of inadequately treated products such as wool, skins, hides or hair.

3.2 Social, economic and environmental effects

Incidents and outbreaks of anthrax can seriously affect Australia's export of livestock and animal products.

At the farm level, the main losses would be from mortalities, which can be high, and from an inability to trade while quarantine restrictions are in place. There would be an increased cost associated with vaccinating animals, particularly if the control program does not provide for this contingency. Since outbreaks would probably not continue for more than 2 months until the lifting of restrictions, long-term economic effects are unlikely.

Public concern about an anthrax outbreak may result in unnecessary boycotts of livestock markets, and even sporting and social events in the area, leading to economic, social or emotional impacts on individuals and the community.

3.3 Critical factors for an Australian response

When formulating a response strategy for anthrax, the major factors to consider are as follows:

- Environmental contamination can be minimised by reducing the opportunity for vegetative bacteria to sporulate by
    - not opening carcasses
    - isolating the carcasses, followed by complete destruction of them and potentially contaminated byproducts
    - thoroughly decontaminating death sites and other contaminated areas.
- Further cases can be prevented by vaccinating susceptible livestock.
- The risk of human infection should be minimised.
- Early detection of further cases can be ensured by proper monitoring.
- Movements of milk and people are not important in the spread of anthrax.
- Under Australian conditions, most outbreaks of anthrax are sporadic in nature.
- Anthrax will spread unless strict controls are placed on premises where sporadic cases occur.

- Unusual outbreaks, when they occur, can result in difficulties in trade.
- Animals, or products from animals, that are potentially incubating anthrax may not be able to be certified for export.

4 Policy and rationale

4.1 Introduction

Anthrax is a World Organisation for Animal Health (OIE)–listed animal disease that has the potential to affect many animals within a herd. It is important in the trade of livestock and livestock products, and is a significant public health issue. Anthrax is a notifiable disease in all states and territories of Australia.

A major outbreak of anthrax would cause severe production losses to affected producers, with potential dislocation and financial losses to the livestock industries as a result of effects on exports. There is significant potential for fatal human disease.

4.1.1 Summary of policy

The policy is to control anthrax in Australia using a combination of strategies, including:

- *prompt reporting* and *diagnosis* of suspected cases
- *quarantine* of infected premises (IPs) to minimise spread of infection
- *disposal* of carcasses to minimise spread of infection
- prompt *vaccination and/or treatment* of at-risk livestock
- *decontamination* of the environment at death sites, and of facilities, products and equipment that may have been contaminated
- *epidemiological investigation* to promptly identify the source of infection and record where anthrax has occurred in livestock
- *tracing* of livestock movements in and out of IPs
- *ensuring the safety of livestock products* by preventing potentially infected livestock and livestock products from being processed for human or animal consumption, or industrial use
- *regular vaccination* of susceptible livestock located on sites with a known history of anthrax, to prevent cases occurring
- a *public awareness campaign* to ensure reporting of sudden, unexplained deaths of livestock, and to reduce the risk of human infection, by providing advice to people handling livestock
- *liaising with public health authorities* in the event of a suspected or confirmed human anthrax case
- using *recording systems to provide accurate data* from investigations to assure *area and farm freedom* from anthrax, enabling accurate certification of livestock and livestock products; and communicating anthrax surveillance information to industry and trading partners
- in unusual outbreaks, *establishing a vaccination area* around IPs, encompassing premises with common circumstances to the IP within which livestock are vaccinated, and placing premises under movement restrictions.

4.1.2 Case definition

Confirmed case

For the purpose of this manual, a confirmed case of anthrax is defined as laboratory-confirmed infection in a susceptible animal with clinical signs (see Table 4.1 for more information).

Notes:

- Positive serology in the absence of detection of *Bacillus anthracis*, with no clinical or epidemiological evidence supporting infection, does not constitute a definition of a case.
- AUSVETPLAN case definitions guide when a response to an emergency animal disease (EAD) incident should be undertaken. AUSVETPLAN case definitions do not determine when international reporting of an EAD incident is required.
- At the time of an outbreak, revised or subsequent case definitions may be developed with the agreement of the Consultative Committee on Emergency Animal Diseases – CCEAD.

Suspect case

Anthrax cases are suspected when there are clinical signs and a history consistent with anthrax infection, and the cases have a high index of suspicion (ie a known property history of anthrax, and surrounding properties with a known history of anthrax).

Suspect cases with a high index of suspicion will require further laboratory investigation to obtain a definitive diagnosis in situations where:

- the carcass(es) is old or putrified, or
- the blood samples collected are older than 48 hours, or
- certain species (eg pigs), where the numbers of anthrax bacilli in the blood at death are very low, are involved, or
- animals have recently been treated with effective classes of antibiotics before death.

Suspect cases with a low index of suspicion include those that have no known property history of anthrax, surrounding properties with no history of anthrax, and a case history not suggestive of anthrax.

Table 4.1 Case definitions for anthrax

Term	Definition	Laboratory testing	Comment
Confirmed	History and/or clinical signs consistent with anthrax and laboratory-confirmed diagnosis	Anthrax confirmed by bacterial culture, microscopic examination of smears or PCR testing	Definitive diagnosis and case definition
Suspect	History and/or clinical signs consistent with anthrax, and a positive immunochromatographic test, but not confirmed by bacterial culture, microscopic examination of smears or PCR testing	Positive immunochromatographic test, but not confirmed by bacterial culture, microscopic examination of smears or PCR testing	High index of suspicion, but not definitive diagnosis, as bacterial culture, microscopic examination of smears or PCR testing has not occurred
Negative	Field and laboratory investigations complete and no evidence of anthrax found	Confirmed as negative by laboratory testing of appropriate samples	Investigation complete and no anthrax detected

PCR = polymerase chain reaction

4.1.3 Cost-sharing arrangement

In Australia, Anthrax is included as a Category 3 emergency animal disease in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses (EAD Response Agreement – EADRA).[11] When cost sharing of the eligible response costs of an incident is agreed, Category 3 diseases are those for which costs will be shared 50% by government and 50% by industry.

4.1.4 Criteria for proof of freedom

The OIE has not defined freedom from anthrax. Proof of freedom is unrealistic for anthrax, since spores can survive in soil for many years. Instead, the issue is to be able to declare, with confidence, that an unusual outbreak is over. In the case of the unusual outbreak in Victoria in 1997, the declaration was made when:

- the epidemic curve had returned to the baseline – new IPs were no longer being recorded on a regular basis
- the numbers of new cases of anthrax on known IPs had fallen to a low level.

These criteria are met 20 days after the epidemic curve returns to the baseline with low numbers of confirmed cases (ie the incubation period specified in the OIE Terrestrial Code).

4.1.5 Governance

Governance arrangements for the response to EADs are outlined in the **AUSVETPLAN *Overview***.

Information on the responsibilities of a state coordination centre and local control centre is available in the **AUSVETPLAN management manual *Control centres management* (Parts 1 and 2)**.

Disease-specific governance issues

For incidents of anthrax, states and territories report events as they occur to the Office of the Chief Veterinary Officer (Australian Government), who incorporates this information into routine reports to the OIE. States and territories will also notify their own health authorities and food authorities.

States and territories are to report unusual outbreaks immediately to the Office of the Chief Veterinary Officer (Australian Government), who will incorporate this information into an emergency report to the OIE.

The chief veterinary officer (CVO) in the relevant state or territory may declare an 'unusual outbreak' when a number of cases occur on more than five premises within a defined geographical area in a short period of time. A 'sporadic incident' is where there are single or few cases on fewer than five premises, and further cases on these premises are prevented by vaccination.

The procedures described in the previous section (Section 4.1.5) relate to unusual outbreaks.

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

4.2 Public health implications

Anthrax is a serious human disease and may be fatal if exposure to the organism is not treated promptly. However, anthrax is not highly transmissible from carcasses because the organism occurs in long filaments or chains, and hence is not readily aerosolised. The disease has not occurred in people on affected farms unless they have had close contact with an infected carcass or contaminated machinery – for example, through contact between broken skin and carcasses during butchering. Although no cases have occurred in Australia, *B. anthracis* (anthrax – virulent strains) has been included in the Security Sensitive Biological Agents List under Part 3 of the *National Health Security Act 2007*.[12]

People handling carcasses, tissues or body fluids of animals known to be, or suspected of being, infected with anthrax, and people handling live vaccines, should use appropriate personal protective equipment (PPE; protective glasses, gloves and clothing), and protect skin breaks from infection (WHO 2008). Medical advice should be sought immediately if any exposure without appropriate PPE occurs, or if exposure to infection through wounds or self-inoculation occurs while animals are being vaccinated with live vaccine.

Animal health authorities must advise the local public health authorities when anthrax is suspected or confirmed and ensure that appropriate referral procedures are established.

There is no epidemiological evidence for the need for additional protection, such as body suits, or respiratory masks or hoods when people are handling infected carcasses. Currently, worldwide, there are no recommendations for using additional protection (Inglesby et al 2002, WHO 2008). However, for environmental sampling, people should use a respirator for protection where there is a possibility of aerosolising and inhaling dust.

4.3 Control and eradication policy

The policy objective is to control anthrax in Australia. Since anthrax is an exceptional occurrence in Australia – but not an exotic disease – its control is already well established through field response programs by national, state and territory government authorities.

All of the principles recommended in the World Health Organization (WHO) guidelines *Anthrax in humans and animals* (WHO 2008, Annex 6, 'Contingency plan for the prevention and control of anthrax') are applied. State and territory legislation requires the notification of a suspicion of anthrax, quarantine of premises when anthrax is confirmed or suspected, vaccination of all livestock at risk, disposal of carcasses and disinfection.

Control measures are applied according to the two patterns of occurrence: sporadic incidents and unusual outbreaks.

4.3.1 Epidemiological assessment

Epidemiological investigation or assessment draws on multiple sources of information to build understanding of the disease and how it is behaving in an outbreak. This helps inform response decision making.

[12] www.health.gov.au/SSBA

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

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

Epidemiological assessment, and tracing and surveillance activities (see Section 4.3.3) in an EAD response are interrelated activities. Early findings from tracing and surveillance will be inputs into the initial epidemiological assessment (eg considering spatial distribution of infection). The outcomes of the initial epidemiological assessment will then guide decisions on subsequent tracing and surveillance priorities.

The outcomes of the epidemiological assessment will also be used to guide the selection of other appropriate response measures (including the application of movement controls) and assess the progress of disease control measures.

Ongoing epidemiological assessment is important for any EAD response to aid evaluation of the continued effectiveness and value of response measures. Ongoing epidemiological assessment will consider the outcomes of tracing and surveillance activities, and will contribute evidence to support any later claims of disease freedom.

4.3.2 Biosecurity and movement controls

See Section 5 and Section 6 for details on declared premises and areas, and recommended quarantine and movement controls.

Quarantine

Premises will be declared (see Section 5.3). Quarantine will be immediately imposed on all premises on which infection is either known or suspected.

Movement controls

As a general principle, the aim of movement controls is to reduce the spread of disease by preventing the movement of infected animals and infected animal products, and by allowing movements that pose a minimal risk.

Section 6.4 provides details on movement controls for live animals, animal products and byproducts, carcasses, and other items that might be contaminated.

4.3.3 Tracing and surveillance

Tracing

Epidemiological investigation will be undertaken to determine the origin of infection, and to trace the movements of livestock and livestock products on and off affected premises.

If an incubating animal was suspected of initiating herd infection, trace-back and investigations will occur on the stock, livestock and carcass waste, equipment and vehicles associated with the movement, and people who had contact with carcasses. Managers of earlier properties of residence and people in charge of the stock will be contacted to establish whether there have been sudden, unexplained deaths that could have been due to anthrax, and follow-up surveillance will be implemented, where appropriate.

With both introduced and on-property infections, trace-forward investigations must be implemented. All animals that left the IP in the 20 days before the occurrence of the index case must be assessed for risk of exposure to anthrax infection. Where a risk of infection exists, these stock will be quarantined and inspected. Consideration will be given to whether vaccination of these livestock is warranted.

The National Livestock Identification System (NLIS) for cattle,[13] or documents such as National Vendor Declarations (NVDs) or Animal Health Statements, will be used to assist with the epidemiological investigation.

To ensure the tracing of any livestock that have left the IP in the 20 days before the presumptive index case and have been transferred to a live export preparation premises, or have been exported, the Australian Government Department of Agriculture, Water and the Environment must be notified of the diagnosis as soon as a case is confirmed.

The NLIS database will also be used to determine where cattle have been slaughtered. The database will typically have a record of the date of slaughter and the body number. If cattle have been moved to slaughter after the presumptive index case, the relevant licensing authority (the Australian Government Department of Agriculture, Water and the Environment, or a state meat hygiene authority) should be promptly notified.

Although industry participants have a legal obligation to register cattle movements on the NLIS database, compliance cannot be assumed. Movement records held by producers, including copies of NVD forms and waybills, may need to be checked to verify that the movement history on the NLIS database is complete and accurate.

Records of each suspected anthrax case will be collected, including the details of:

- the herd history (particularly recent, unexplained, sudden deaths; vaccination status for anthrax and clostridial diseases; treatments; supplementary feeding; location of stock; and recent stock movements)
- the property (eg information on topography, use of fertilisers including organic fertilisers, vegetation, pastures, soils, stock water supplies, recent earthworks, rainfall, irrigation, drainage, average daily temperatures in the period immediately before the occurrence of anthrax)
- contaminated areas, such as death or burial sites, preferably including global positioning system (GPS) coordinates.

State and territory registers of Property Identification Codes and associated databases should record pertinent epidemiological information, particularly information on contaminated areas, and retain this information indefinitely.

When anthrax incidents occur in sheep, NLIS (Sheep & Goats) can trace mobs of sheep using a mob-based system. The NLIS, in this instance, uses visually readable ear tags that have Property Identification Codes printed on them. When mobs are transported, they are accompanied by a movement document (such as an NVD or a waybill).

[13] www.nlis.com.au

Surveillance

In sporadic incidents, targeted surveillance should be initiated and maintained on IPs and neighbouring premises to determine the timing of any new incidents and when deaths cease. Unusual outbreaks require active surveillance over a wider area to ensure that the boundaries of infection can be established, for determining the boundaries of the vaccination area (see Section 4.3.6).

When planning an effective and efficient program that can demonstrate control of an unusual outbreak, the following elements should be considered:

- Early notification of sudden death of livestock to veterinarians and/or animal health authorities is critical for an effective program.
- A rapid diagnosis can assist with making decisions about appropriate carcass disposal and decontamination. Diagnosis can be sped up by establishing a temporary local laboratory. Consideration should be given to using rapid point-of-care screening tests.
- The time when outbreaks might have begun, estimated from death patterns on premises, provides the point from which trace-forward needs to start to secure meat, skin and hide supplies.
- Effective surveillance is needed to protect markets by ensuring the safety of animal products intended for human consumption. The NLIS can be used to monitor livestock movements from quarantined premises or premises within a declared zone.

Surveillance will continue until it is clear that the unusual outbreak has been brought under control and further cases of anthrax are unlikely.

4.3.4 Zoning and compartmentalisation for international trade

Where it is not possible to establish and maintain disease freedom for the entire country, establishing and maintaining disease-free subpopulations, through zoning and/or compartmentalisation,[14] may be considered.

In the case of a limited disease outbreak, a containment zone[15] may be established around the areas where the outbreak is occurring, with the purpose of maintaining the disease-free status of the rest of the country outside the containment zone.

All zoning applications would need to be prepared by the Australian Government in conjunction with the relevant jurisdiction(s) and agreed to by the CCEAD. Zoning is usually negotiated after a disease outbreak has begun.

Compartmentalisation applications typically need to be negotiated before an outbreak occurs, and will require input from the relevant industries.

Recognition of both zones and compartments must be negotiated between the Australian Government and individual overseas trading partners. Zoning and compartmentalisation would require considerable resources that could otherwise be used to control an outbreak. Careful consideration will

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

[15] The OIE defines a 'containment zone' as an infected zone within a previously free country or zone, which includes all suspected or confirmed cases that are epidemiologically linked and where movement control, biosecurity and sanitary measures are applied to prevent the spread of, and to eradicate, the infection or infestation. The Australian Government Department of Agriculture and Water Resources commissioned a report on what would be required for the establishment of containment zones in Australia. This report is available at www.ausvet.com.au/tools-resources.

need to be given to prioritising these activities, because the resulting competition for resources could delay the quick eradication of the disease and recognition of disease freedom.

Agreements between trading partners take time to develop, consider and finalise, because of the need to provide detailed information on activities such as biosecurity, surveillance, traceability and diagnostics to support the approach that is developed. An importing country will need assurance that its animal health status is not compromised if it imports from an established disease-free zone in Australia. Trading partners may not accept a zoning or compartmentalisation proposal, regardless of the information provided. Eradication of disease may be achieved before zoning or compartmentalisation applications are finalised.

The WOAH guidelines for zoning and compartmentalisation are in Chapter 4.4 and Chapter 8.1 of the WOAH *Terrestrial animal health code*.

4.3.5 Biosafety and biosecurity for personnel

People handling infected animals, carcasses or tissues must wear gloves and protective clothing, and follow appropriate personal disinfection procedures at the conclusion of work, to protect themselves and to prevent further spread of anthrax (WHO 2008).

4.3.6 Vaccination

Vaccination is the key control measure in IPs and outbreak zones. Livestock judged to be at risk, including other susceptible species grazing on or near the land on which the death(s) occurred, should be vaccinated immediately.

Vaccine use in all states and territories requires CVO approval. Approval would normally be given to vaccinate all at-risk livestock on all IPs and declared vaccination areas in an unusual outbreak, as well as on premises neighbouring IPs in sporadic incidents.

Official quarantine applies for at least 20 days after the last case on an IP, and a 42-day meat withholding period applies to the slaughter of vaccinated animals for human consumption. Vaccinated stock on IPs and contiguous premises must not move off the premises until the quarantine or movement restrictions are removed.

Vaccination is compulsory on all IPs and on all premises in a declared vaccination area. It may or may not be compulsory on neighbouring premises in sporadic incidents. If compulsory vaccination is not required on neighbouring properties, the owners may be permitted to vaccinate voluntarily, at the CVO's discretion.

When vaccination is being carried out, new stock introduced onto premises, and calves and lambs approaching 2 months of age require prompt vaccination. Introduced stock vaccinated on arrival should not be put into known infected paddocks until immunity has had the opportunity to develop (about 10–15 days).

Affected properties should revaccinate all animals annually, for as long as a risk assessment deems necessary. Revaccination should occur before the time of year when there is greatest risk of infection with anthrax spores (usually summer, but could be any time that the pasture dries off and animals graze close to the ground, or conditions are dusty). The revaccination should be at least 6 months after the first vaccination, to boost immunity should there be a high-challenge situation. Annual vaccination is in accordance with manufacturers' recommendations. It is a precautionary measure to minimise the risk of further cases, although possibly unnecessary for many animals. In sporadic incidents,

neighbouring properties would not normally be required to revaccinate except under special circumstances. Neighbouring properties and other premises in the vaccination area of an unusual outbreak might be required to revaccinate annually for up to 3 years after the last case.

Feedlots should implement a policy on vaccination that is developed in conjunction with veterinary authorities.

Where vaccination is performed, vaccinated animals will be effectively identified and not slaughtered for human consumption until after the 42-day meat withholding period.

The ordering and use of vaccine from the national vaccine bank (managed by Animal Health Australia) can only occur through the authorisation of the CVO of the relevant jurisdiction.

Implementation of vaccination area

In an unusual outbreak, the CVO will decide whether to implement a vaccination area. This decision will be based on potential advantages to trade within and beyond Australia. A vaccination area is implemented by declaring an area around IPs where all susceptible animals are vaccinated. All premises in the vaccination area are subject to quarantine, with a mandatory movement embargo.

The area is determined on the basis of a range of factors, including progression of infection; climatic conditions; topography and stocking density; the distribution of affected premises; the epidemiology and pattern of disease occurrence in the outbreak; and legal, natural or built barriers, such as rivers or roads, that can provide readily identifiable boundaries, consistent with the OIE Terrestrial Code. The area may follow the boundaries of a legally defined entity, such as a local government area or parish.

When a vaccination area is declared, boundaries and movement controls on individual premises within the area are enforced by government officers authorised under the affected state's or territory's animal disease control legislation. In unusual outbreaks, intensive surveillance would be undertaken within the declared vaccination area and surrounding areas, with suspect carcasses being subjected to laboratory testing.

4.3.7 Treatment of infected animals

It is unusual for herbivores to be seen sick with anthrax, so there is no opportunity for treatment. However, dairy animals, which are under close observation, may have an opportunity for antibiotic treatment.

Antibiotic treatment of valuable infected animals may allow complete recovery if given early in the course of the disease. However, as antibiotics interfere with the development of immunity after vaccination, the treated animals will need to be identified and revaccinated as soon as possible if antibiotics have been given within 10 days of vaccination. The appropriate withholding period(s) for the antibiotic must be observed.

Widespread antibiotic treatment of animals exposed to anthrax infection is not supported.

4.3.8 Treatment of animal products and byproducts

Milk

Milk and dairy products are considered to be very low risk for anthrax in Australia because:

- the milk from infected cows does not contain *B. anthracis* until close to death or after the cow dies
- milk from unwell animals is not added to the farm milk vat – unwell animals are milked separately, and the equipment used in collection is disinfected following milking
- vegetative anthrax organisms cannot survive (or sporulate) in unpasteurised milk, and pasteurisation kills all vegetative organisms
- herds are vaccinated with Sterne 34F2 strain vaccine, an avirulent and non-encapsulated organism that is not excreted into milk.

If the veterinary authority is satisfied that Annex 6, Part 3 from the WHO guidelines (WHO 2008) has been met, milk from healthy animals in herds or flocks in which cases of anthrax have occurred need not be excluded from processing, and bulked supplies containing such milk need not be condemned.

The milk from herds undergoing vaccination may be used for human consumption, provided that appropriate handling and processing standards are maintained.

Meat

Meat and meat products derived from animals processed for human consumption in Australia are considered to be very low risk for anthrax because:

- IPs are immediately quarantined, and animals on the farm are vaccinated; in unusual outbreaks, animals on surrounding premises are compulsorily vaccinated
- diagnostic tests are applied to all animals dying suddenly within and outside the vaccination area in an unusual outbreak
- all vaccinated stock are withheld from slaughter for at least 42 days after vaccination
- all animals for slaughter receive antemortem and postmortem inspections.

Property Identification Codes for any farms that have had a case of anthrax or have had their herds vaccinated against anthrax are entered on an anthrax database. This database is available to government officers to ensure that no livestock are traded within the prescribed meat withholding period. Performance audits are undertaken on farms, at saleyards and at other locations to verify compliance. Breaches of quarantine or meat withholding period requirements can result in substantial penalties. The farms remain on the database while they are in quarantine or while there are livestock on the property within the meat withholding period for anthrax vaccination.

Hides, skins and wool

Carcasses of animals infected with anthrax are burnt on site where possible (see Section 4.3.10). To help contain infection and reduce sporulation, hides, hair or wool are not permitted to be taken from infected carcasses.

Hides, skins, hair and wool can be treated for occupational health purposes using methods such as those outlined by WHO (2008; formaldehyde or ethylene oxide fumigation for hides and skins, and the Duckering process for wool and hair) or gamma irradiation.[16]

Knackery products

Products from animals that have died from anthrax are not allowed to move off IPs. These products, as well as products that have been removed to a knackery before diagnosis on the IP and any other products that have been in contact with affected animals, will be traced and disposed of by burning. The premises will then be decontaminated.

[16] Refer to Australian Government Department of Agriculture, Water and the Environment for the appropriate treatment dose

Other products from IPs

Other animal products sourced from IPs are subject to inspection, assessment and treatment to destroy any possible infective organisms. The treatment applied to products from infected zones will depend on the type of product, the nature of any declared area and the status of the premises.

4.3.9 Destruction of animals

Stamping out

Stamping out or slaughter of in-contact animals on IPs is not an appropriate control measure for anthrax.

4.3.10 Disposal of animals, and animal products and byproducts

Where anthrax-affected cattle carcasses carry an NLIS tag, the tag number must be recorded either electronically or manually before the carcass is incinerated.

Disposal of animals that have died from anthrax, and associated materials, will take account of the epidemiology of anthrax (see Section 2.4).

Burning of carcasses at the death site and burial of the ashes under the control of government officers is the recommended method to dispose of infected animals in Australia, unless this method is precluded by other factors. All anthrax burial sites need to be permanently identified (see Section 4.3.3).

Where carcasses are not burnt on site, the head should be enclosed in a plastic bag and the body wrapped in double-thickness, heavy-duty plastic (to prevent the spilling of body fluids). The carcass may then be moved to a central burning site. The death site should then be decontaminated (see Section 4.3.11).

In some areas of Australia, it is impractical to burn carcasses for fire safety reasons, and other ways to prevent carcasses from becoming future long- or medium-term sources of infection need to be considered. Subject to risk assessment, an alternative strategy for carcass disposal is leaving dead animals intact to putrefy, after first liberally treating the carcass and surrounds with 3.7% formaldehyde. This strategy relies on the fact that formaldehyde destroys spores, and that spores in the environment are more fragile when exposed to full environmental conditions. It follows principles established in Cyprus, where an aggressive program to bypass carcass burial led to anthrax freedom (M Hugh-Jones, Department of Epidemiology and Community Health, School of Veterinary Medicine, Louisiana State University, pers comm, 1998). Carcasses also need to be protected from predator attack.

Note: Formaldehyde also prevents scavenging of carcasses (ProMed-mail 2010).

4.3.11 Decontamination

Vegetative *B. anthracis* is susceptible to a wide range of disinfectants and low-temperature heat treatment. The spores are much more resistant to destruction, but chemicals are available to clean and disinfect premises, other items and people. Decontamination is an essential part of the control program and must be rigorously applied.

The chemicals used to destroy anthrax spores are potentially dangerous and should be used only by trained personnel in accordance with appropriate instructions and while wearing appropriate PPE. Material safety data sheets must be available and consulted, where necessary.

The rapid removal of infected and suspect cases of anthrax, their rapid and safe disposal, and treatment of death sites significantly reduce the load of infection at IPs.

Personnel, clothing and equipment

Disinfectants such as 1% chloramine-T or 10% formalin[17] (3.7% formaldehyde)[18] used for 2 hours, or 0.05% sodium hypochlorite for 30 minutes, are effective against bacterial spores on clothing and small equipment. Boiling materials for at least 20 minutes will also destroy spores.

Contaminated sites and materials

Death sites will be decontaminated using, for example, 10% formalin (3.7% formaldehyde) at a rate that saturates the soil surface (5 L/m^2), 2% glutaraldehyde[19] for 2 hours, or 3% peracetic acid for 30 minutes (Greg A Smith, Microbiological Security Officer, CSIRO-AAHL, pers comm, 2010; Block 2001). Contaminated soil, bedding, manure, unused feed and so on should be decontaminated in situ for at least 12 hours with 10% formalin (3.7% formaldehyde), ensuring full penetration of the fluids, or 10% neutral calcium hypochlorite at a rate of 5 L/m^2. Alternative treatments for contaminated sites and soil are 10% caustic soda (sodium hydroxide) solution or 15% basic calcium hypochlorite; these solutions need to be applied at 10 L/m^2.

Heavy equipment and livestock transports

Equipment or trucks in which infected animals or carcasses have been transported or have died must undergo preliminary disinfection before they are cleaned. Contaminated areas should be saturated twice with an appropriate disinfectant at a rate of 1 L/m^2, with 2 hours between treatments, and then left for 3 hours before cleaning. Appropriate agents are 10% formalin (3.7% formaldehyde), 2% glutaraldehyde or 10% calcium hypochlorite solutions. Equipment and vehicles should then be thoroughly cleaned with detergents and water. This should be followed with a spray of 10% formalin (3.7% formaldehyde), 2% glutaraldehyde, 10% calcium hypochlorite or 1% chloramine at a rate of 1 L/m^2, and the equipment left for at least 2 hours.

Note that hypochlorite solutions are inactivated by the presence of organic materials and are corrosive for many metals. If used on metal surfaces, they should be rinsed off after the required exposure time.

Premises

The risk of contamination of buildings, yards, trucks and equipment must be carefully assessed.

Premises must undergo preliminary disinfection before being cleaned. Disinfectant solutions that can be used are 10% hot caustic soda (sodium hydroxide) solution, 10% formalin (3.7% formaldehyde), 2% glutaraldehyde, or chlorine disinfectants such as calcium hypochlorite (10% active chlorine); chlorine disinfectants are sporicidal but are rapidly inactivated by the presence of organic material. These solutions are applied twice at a rate of 1 L/m^2, 2 hours apart, and left for 3 hours, followed by cleaning with detergents and then a final disinfection, as described in the above section.

[17] Formalin should be used only when no alternatives exist, and then only by experienced personnel using appropriate safety equipment; refer to the Decontamination Manual for more information

[18] Formalin is a solution of formaldehyde (a gas) in water. One hundred per cent formalin has approximately 37% formaldehyde. For simplicity, concentrations of formalin are used, where possible (WHO 2008).

[19] Use of glutaraldehyde requires appropriate respiratory and skin protection. Safety precautions on the product label and the material safety data sheet should be observed.

Further information on decontamination can be obtained from WHO (2008) and the **AUSVETPLAN operational manual *Decontamination***.

4.3.12 Vector management

Vaccination and herd immunity will limit the spread of anthrax by vectors. Rapid identification and removal of infected carcasses and their safe disposal will help to reduce background contamination by carrion insects. If carcass disposal is delayed, carcasses can be sprayed with insecticides, if necessary, to reduce carrion insects.

4.3.13 Public awareness and media

Anthrax is a sensitive issue, both with respect to public health perceptions and in relation to trade, particularly with some trading partners.

Sporadic outbreaks rarely generate a significant amount of media attention, and this is usually only at a local level. Unusual outbreaks – especially the associated burning activities – might involve extensive media scrutiny and reporting. A media campaign must emphasise to cattle producers the importance of inspecting susceptible animals regularly, and quickly reporting illness or sudden deaths. Details of any imposed movement controls need to be readily available and clearly explained to industry representatives.

Given the important zoonotic implications of anthrax, people at risk must be advised of appropriate occupational health and safety requirements, and health authorities should be alerted to the potential for human infection. There will be a need to allay public concerns about the safety for human consumption of meat, dairy products and other animal products derived from healthy animals that are subjected to the routine inspection and processing regimes used in Australia.

If necessary, particularly for unusual outbreaks, the state/territory and Australian CVOs, public health representatives and peak industry representatives will develop a public communications strategy. This will include appointment of spokespersons and, if necessary, notification of Australian overseas posts and trading partners.

4.4 Funding and compensation

Details of the cost-sharing arrangements can be found in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses.[20] Details of the approach to the valuation of, and compensation for, livestock and property in disease responses can be found in the **AUSVETPLAN operational manual *Valuation and compensation***.

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

5 Declared areas and premises

When an emergency animal disease (EAD) is first suspected, the premises involved would undergo a clinical and/or epidemiological investigation. If the case definition, as defined in the relevant AUSVETPLAN response strategy, is met (ie the index case[21]), the relevant chief veterinary officer (CVO) or their delegate will determine the premises classification and may declare the premises an infected premises (IP).

After the identification of the first IP, a restricted area (RA) and a control area (CA) may be declared.[22] A transmission area (TA) may also be defined, if appropriate. All premises within these areas will be classified.

At the beginning of an EAD incident, the initial premises classifications would be IP, at-risk premises (ARP), premises of relevance (POR), unknown status premises (UP) and zero susceptible species premises (ZP).

Any premises within the RA or CA will have only one classification at any one time. After an epidemiological investigation, clinical assessment, risk assessment or completion of control measures, a premises may be reclassified.

Once the first IP has been identified, intelligence gathering through veterinary epidemiological investigations would quickly lead to the identification of suspect premises (SPs) and trace premises (TPs). These would be high priorities for follow-up investigation by the relevant state or territory authorities. In a worst-case scenario, an SP could become an IP; therefore, SPs need to be investigated as a matter of very high priority. Similarly, investigation and risk assessment of a TP might identify it as an IP, dangerous contact premises (DCP) or dangerous contact processing facility (DCPF). An SP or TP might also be assessed as negative and qualified as SP-AN or TP-AN, and eventually reclassified as an ARP, POR or ZP.

All premises classifications are subject to change as a result of a modification in the case definition(s) or investigation(s) as the incident response proceeds.

Classifications should be applied with information needs of managers in mind. They should assist managers to monitor and report progress. Premises classifications to be used should be agreed early in a response, so that control centre personnel can apply the correct and consistent classifications and definitions from the outset of the investigation and response.

5.1 Declared areas

Declared areas are not applicable to anthrax in Australia.

5.1.1 Restricted area (RA)

RAs are not applicable to anthrax in Australia.

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

[22] This is invariably the case with highly contagious diseases (eg foot-and-mouth disease, equine/avian/swine influenza, classical swine fever) but may not apply to less contagious diseases (eg Hendra virus, anthrax, Australian bat lyssavirus).

5.1.2 Control area (CA)

CAs are not applicable to anthrax in Australia.

5.2 Other areas

With an unusual outbreak, a decision will be made on whether to implement vaccination areas (VAs). Implementation of such areas is not required for sporadic incidents.

A VA will be a relatively small buffer area around IPs, declared under legislation, that is subject to vaccination, intense surveillance and movement controls. Movement into and out of the area will, in general, be prohibited, with any movement being only by permit. All vaccinated premises in the VA will be subject to quarantine or legal agreement, with a mandatory movement embargo, and all at-risk animals on these premises will be vaccinated.

The VA will be clearly delineated by recognisable natural, artificial or legal boundaries. The boundaries will be continuously supervised, and the movement of animals and animal products will be controlled. The extent of the VA will be determined by the state or territory CVO on the basis of a range of factors, including progression of infection, climatic conditions, topography and stocking density.

In unusual outbreaks, intensive surveillance will be undertaken within the declared area and the area surrounding the VA. Dead stock will be subjected to laboratory testing for anthrax.

The VA will be rescinded when most, if not all, premises within the VA have been released from quarantine or legal agreement.

5.3 Premises classifications

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

Based on the disease risk they present, the highest priorities for investigations are IPs, DCPs and SPs.

In a disease outbreak, not all classifications may be needed. Premises classifications are mutually exclusive – that is, a given premises can have only one classification at any given time. After an epidemiological investigation, clinical assessment, risk assessment or completion of control measures, a premises may be reclassified.

5.3.1 Premises status classifications

Infected premises (IP)

A premises classified as an IP will be a defined area (which may be all or part of a property) in which anthrax is confirmed and where quarantine served by notice is in place. An IP is subject to control procedures.

Suspect premises (SP)

SPs are applicable to anthrax cases in Australia.

SP classification will apply to premises in the area of an IP that report cases of sudden death that are yet to be investigated.

Dangerous contact premises (DCP)

DCPs are applicable to anthrax cases in Australia.

DCP classification will apply to the following:

- properties that received susceptible livestock from an IP within 20 days before a positive anthrax case
- properties that supplied livestock that were subsequently suspect cases to an IP within 20 days before a positive anthrax case.

Unknown status premises (UP)

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

If an investigation and epidemiological risk assessment on a UP confirmed:

- the presence of an infected animal or contaminated animal products, wastes or things, the premises would be classified as an IP
- a high-risk epidemiological link but without clinical signs of an EAD, the UP would be reclassified as a DCP
- the presence of susceptible animals and a risk assessment indicates that vaccination is warranted, the UP would be reclassified as an ARP
- clinical signs similar to the case definition, the UP would be reclassified as an SP
- that it contained no susceptible animals and/or risk products, wastes or things, the UP would be reclassified as a ZP.

Zero susceptible species premises (ZP)

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

5.3.2 Qualifiers

The following qualifying categories may be added to a property status. Also refer to the **AUSVETPLAN guidance document *Declared areas and allocation of premises classifications in an emergency animal disease response***.

Assessed negative (AN)

Not applicable.

Vaccinated (VN)

VN is a qualifier that can be applied in a number of different ways. At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against anthrax. However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used in different ways to track a range of criteria and parameters. The details would need to be developed and tailored to meet individual needs of jurisdictions and circumstances.

Some of the issues that could be included for consideration are detailed below.

Definition and monitoring of vaccination

The vaccination status of a population of animals or premises might be important when considering movement controls.

For the purposes of AUSVETPLAN, the following guidance should be followed.

To be referred to as a vaccinated population, the population must have been vaccinated in accordance with:

- the Australian Pesticides and Veterinary Medicines Authority (APVMA) registered label particulars, or
- APVMA-approved permit instructions relating to an approved Emergency Animal Disease Response Plan for off-label use or use of an unregistered immunobiological product(s), or
- instructions of the relevant CVO.

Monitoring vaccination programs

A mechanism for recording and monitoring primary and booster vaccinations for all vaccinated animals should be part of the disease control monitoring system, to provide information on the control of the outbreak. For example, jurisdictions may choose to add numbers to the qualifiers to indicate primary (VN1) or booster (VN2) vaccinations.

Vaccination records and identification of vaccinated animals

The key requirement in an EAD response in which vaccine is used will be to identify vaccinated animals (fully or partially) so they can be disposed of appropriately. Records of the number of doses administered and their timing can be kept to identify fully vaccinated premises and premises that have not completed the planned vaccination program (partially vaccinated) or are overdue for booster vaccinations.

In cattle, the National Livestock Identification System (NLIS) can record the animals vaccinated. For other species, the NLIS still relies on mob identification. Where appropriate, individual animal identification by means other than NLIS (eg individual animal management tags, microchips (radio-frequency identification), collars) may be necessary.

5.4 Reclassifying premises and previously declared areas

Not applicable.

6 Movement controls

6.1 Principles

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

- Containment and eradication of anthrax is the highest priority. Therefore, 'normal business movements' are not allowed.
- Recommended movement controls apply to any movement off a premises, whether on foot or by vehicle, that involves either public or private land.

6.2 Guidelines for issuing permits

Not applicable.

6.3 Types of permits

Permits are either general or special. Emergency permits are a form of special permit. Permits are legal documents that describe the animal(s), commodities or things to be moved, the origin and destination, and the conditions to be met for the movement. Either type of permit may include conditions. Once permit conditions have been agreed from an operational perspective, all permit conditions must be met for every permit. Both general and special permits may be in addition to documents required for routine movements between or within jurisdictions (eg health certificates, waybills, consignment notes, National Vendor Declarations – NVDs).

General permit

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

Special permit

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

Emergency permit

An emergency permit is an SpP that specifies strict legal requirements for an otherwise high-risk movement of an animal, to enable emergency veterinary treatment to be delivered, to enable animals

to be moved for animal welfare reasons, or to enable any other emergency movement under exceptional circumstances. These permits are issued on a case-by-case basis under the authorisation of the relevant CVO.

Other movement requests

Movements not reflected within any of the movement control matrixes or narratives may be considered by the relevant jurisdictional CVO on a risk-assessed case-by-case basis.

6.4 Recommended movement controls

Anthrax is a notifiable disease in animals in all states and territories of Australia under legislation that provides the necessary powers for effective disease control. All premises where anthrax has been diagnosed or suspected will be subject to immediate quarantine, with strict controls on all livestock movements. The boundary of the quarantine area will be determined by risk assessments of the following that have, or might have, been exposed to viable *Bacillus anthracis* and might be infected or contaminated:

- stock of the same species as the affected stock
- stock of other species
- stock products and byproducts, land, facilities and equipment.

Stock determined from tracing (see Section 4.3.3) as being from the same epidemiological unit as the affected stock will also be quarantined.

Movement controls will be enforced on quarantined infected premises (IPs) and vaccinated animals on contiguous premises. Movement controls will be audited against records on the National Livestock Identification System (NLIS) database, where applicable.

For sporadic incidents, movement controls will apply to individual premises. Individual premises will be released from movement restrictions when they meet the following criteria:

- IPs – a minimum of 20 days after the last case. (Note: A 42-day meat withholding period will apply to the slaughter of vaccinated animals for human consumption.)
- Contiguous premises that have been vaccinated but have not had a case of anthrax – a minimum of 20 days after vaccination of susceptible animals on the farm is completed. (Note: A 42-day meat withholding period will apply to the slaughter of vaccinated animals for human consumption.)
- IPs without animals (such as a knackery that had received an infected carcass) – on completion of thorough decontamination and inspection by a government inspector.

Unusual outbreaks are considered to be over once the epidemic curve has returned to baseline for at least 20 days. Notwithstanding this criterion, individual premises must still satisfy the criteria for release from quarantine or other restrictions as specified for sporadic incidents (above). Individual premises may be held in quarantine for longer periods at the discretion of the relevant state or territory CVO, to satisfy zone requirements.

6.4.1 Live susceptible animals

The following guidelines for movement of live animals, carcasses and other items focus on cattle and sheep. Anthrax cases in pigs, horses and other species are unusual under Australian conditions, and movements of these species need to be considered separately following a risk assessment.

The permit conditions are found in **Appendix 2**.

It is important for all producers to comply with the 42-day meat withholding period that applies to the slaughter of vaccinated animals for human consumption.

Table 6.1 describes the recommended movement controls for live cattle and sheep.

Table 6.1 Movement of live cattle and sheep between premises

To→ From ↓	**IP**	**DCP/ DCPF[a]**	**SP**	**ARP**	**Other premises with susceptible livestock**	**Other premises with no susceptible livestock, including abattoirs**
IP[b,c]	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s
DCP	Prohibited, except under SpP — conditions b, d, e, j, k, s	Prohibited, except under SpP — conditions d, f, l, q, r, s	Prohibited	Prohibited, except under SpP — conditions d, f, l, q, r, s	Prohibited, except under SpP — conditions d, f, g, l, q, r, s	Prohibited, except under SpP — conditions h, l, r, s
SP	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited	Prohibited
ARP	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited	Prohibited	Prohibited	Prohibited, except under GP — conditions c, d, i, l	Prohibited, except under SpP — conditions h, l, r, s
Other premises with susceptible livestock	Prohibited, except under SpP — conditions a, d, e, j, k, l, r, s	Prohibited, except under GP — conditions c, d, g, i, l	Prohibited	Prohibited, except under GP — conditions c, d, g, i, l	Allowed (under normal jurisdictional, including inter-state, requirements)	Allowed (under normal jurisdictional, including inter-state, requirements)

ARP = at-risk premises; DCP = dangerous contact premises; DCPF = dangerous contact processing facility; GP = general permit; IP = infected premises; SP = suspect premises; SpP = special permit
a Can include farms, abattoirs and knackeries that have received infected animals.
b Animals on IPs (other than those listed in the conditions of SpP1) and vaccinated animals

within 42 days of a vaccination cannot be slaughtered for human consumption.
c Emergency slaughter of livestock and rendering on a case-by-case basis after risk assessment.

6.4.2 Milk and dairy products

No restriction applies to the movement of milk, provided that:

- the animal is healthy and shows no clinical signs at the time of milking
- when a premises has had a case of anthrax within the previous 20 days, the milk has been chilled promptly and processed using a heat treatment that is at least equivalent to pasteurisation (see Section 4.3.8).

6.4.3 Hides, skin, wool and other fibres

Hides, skin and wool that are harvested during an outbreak and moved off IPs must be destroyed or treated (see Section 4.3.8).

For premises other than IPs, movement of hides, skin and wool must not occur until the premises status is resolved.

6.4.4 Other animal byproducts

Table 6.2 describes the recommended movement controls for carcasses of cattle and sheep.

Table 6.2 Movement of carcasses between premises

To→ From ↓	**IP**	**DCP/DCPF[a]**	**SP**	**ARP**	**Other premises**
IP[b,c]	Prohibited, except under SpP — conditions l, m, n, o, p, r, t, v, w, x, y, z, aa	Prohibited	Prohibited	Prohibited	Prohibited
DCP	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited, except under SpP — conditions u, y, bb, cc
SP	Prohibited, except under SpP — conditions l, m, n, o, p, r, t, v, w, x, y, z, aa	Prohibited	Prohibited	Prohibited	Prohibited

ARP	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited	Prohibited, except under SpP — conditions u, y, bb, cc	Prohibited, except under SpP — conditions u, y, bb, cc
Other premises	Allowed (under normal jurisdictional, including inter-state, requirements)	Allowed (under normal jurisdictional, including inter-state, requirements)	Allowed (under normal jurisdictional, including inter-state, requirements)	Allowed (under normal jurisdictional, including inter-state, requirements)	Allowed (under normal jurisdictional, including inter-state, requirements)

ARP = at-risk premises; DCP = dangerous contact premises; DCPF = dangerous contact processing facility; IP = infected premises; SP = suspect premises; SpP = special permit
a Can include farms, abattoirs and knackeries that have received infected animals.
b Animals on IPs and vaccinated animals within 42 days of a vaccination cannot be slaughtered for human consumption.
c Emergency slaughter of livestock and rendering on a case-by-case basis after risk assessment.

6.4.5 Crops, grains, hay, silage and mixed feeds

Movement of grain, hay and livestock feed off IPs, where these materials have been harvested or stored during an outbreak, is permitted only after a risk assessment showing minimal opportunity for contamination.

7 Appendix 1

ANTHRAX FACT SHEET

Disease and cause

Anthrax is an infectious bacterial disease that can affect humans and a wide range of domestic and wild animals. It is caused by the bacterium *Bacillus anthracis* — a large, gram-positive, rod-shaped bacterium.

Occurrence in Australia

Anthrax occurs sporadically in specific areas of Australia.

Species affected

Anthrax affects many domestic and wild animals, and humans.

Key signs

The clinical forms of anthrax in animals are traditionally described as:

- peracute (very acute) – death occurs suddenly (within a few hours at most) of the onset of clinical signs
- acute – death occurs from 24 hours to a few days after onset
- subacute or localised – disease lasts for several days and might end in recovery
- chronic – recovered animals might show localised swelling and fever, but the only sign might be enlarged lymph glands.

Spread

Anthrax is spread by release of bacterial spores from the carcass of an animal that has died from the disease and the subsequent ingestion of these spores by other animals.

Persistence of the agent

In its vegetative form, *B. anthracis* is fragile, and easily inactivated by disinfectants or exposure to moderate temperatures. It is also destroyed by normal postmortem changes. However, on exposure to air, it forms highly resistant spores that can remain viable for many years in some soils.

8 Appendix 2

PERMIT CONDITIONS

a.	Movement approved by incident controller based on a risk assessment. The incident controller may issue an SpP for movement of unvaccinated bobby calves directly to a domestic abattoir for slaughter.
b.	Emergency movement approved by incident controller based on a risk assessment. The incident controller may issue an SpP for movement of vaccinated cattle and sheep on a case-by-case basis, where the risk of spread of anthrax has been assessed as negligible for the particular movement.
c.	There must be no clinical signs of anthrax in any livestock on the premises up to and including the day of transport.
d.	Movement is to approved destination only.
e.	Livestock must • only go to other quarantined premises, IPs or premises within the vaccination area • be vaccinated more than 14 days before leaving the IP and recorded on the NLIS • have no evidence of clinical disease up to and including the day of transport • be individually identified and specified on the permit for traceability and other purposes.
f.	Livestock must • have no evidence of clinical disease before or during the vaccination program or while being moved • be fully vaccinated – movement can only occur 14 days or more after the last vaccination; vaccinated animals must be identified and recorded on the NLIS.
g.	Livestock must not move off the destination premises, unless there has been a period of surveillance (at least 20 days) before they are moved.
h.	Livestock must • have no evidence of clinical disease before or during the vaccination program or while being moved • go directly to an abattoir and be slaughtered within 48 hours • be vaccinated, and fulfil the 42-day meat withholding period after vaccination before being sent to slaughter • be NLIS compliant.
i.	Livestock must

	• be vaccinated more than 14 days before leaving the premises and recorded on the NLIS • be subject to any restrictions placed on the destination premises.
j.	Vehicles from IPs exposed to infection require disinfection to agreed specifications before leaving the premises.
k.	Transport route must be agreed to and direct.
l.	Vehicles must not stop, load or unload anything during transit.
m.	Vehicles must be disinfected before leaving the premises (see Section 4.3.11).
n.	Vehicles must proceed directly to the disposal site under escort and not collect carcasses from other premises en route.
o.	Vehicles must be decontaminated after carcasses are removed (see Section 4.3.11).
p.	The disposal site must be under quarantine and permanently identified.
q.	Destination premises must be under quarantine or legal agreement (vaccinated premises).
r.	Milk and people do not require a movement permit (see Section 6.4.2).
s.	The permit must accompany the livestock during movement, and the person responsible for the livestock must retain a copy of the permit, consistent with the legal requirements of the jurisdiction.
t.	Identification details of the animal must be recorded before leaving the IP and at the destination premises.
u.	Identification details of the animal must be recorded.
v.	Location of death site must be recorded.
w.	Staff must wear appropriate personal protective equipment.
x.	Carcasses from IPs must only go for disposal, preferably by incineration.
y.	Each carcass must be tested (by smear or point-of-care immunochromatographic (ICT) test) to confirm if it is a case of anthrax.
z.	Carcasses must be loaded on leakproof vehicles.
aa.	Carcasses must be disposed of as soon as practicable on reaching the disposal site.
bb.	If carcasses test positive, the premises is classified as an IP.
cc.	If carcasses test negative, the following points apply • Staff must wear appropriate personal protective equipment. • Carcasses must be loaded on leakproof vehicles. • Carcasses must be disposed of as soon as practicable. • Vehicles must be decontaminated after carcasses are removed.

9 Glossary

9.1 Disease-specific terms

Term	Definition
Cyanosis (adj. cyanotic)	Blueness of the skin and/or mucous membranes due to insufficient oxygenation of the blood.
Knackery	A premises for slaughtering and/or processing animals for pet food, stockfeed or fertiliser, but not for human consumption, often with rendering facilities.
Meatmeal/bonemeal	Meat or bones from rendered animal carcases ground for use as stock feed or fertiliser.
Petechial haemorrhages	Tiny, flat, red or purple spots in the skin or mucous membranes caused by bleeding from small blood vessels.
Rendering	Processing by heat to inactivate infective agents. Rendered material may be used in various products according to particular disease circumstances.
Ruminant	Any of various cud-chewing cloven-hoofed quadrupeds, such as cattle, deer or camels, which usually have a stomach divided into three or four compartments.
Septicaemia	Infection of the bloodstream with bacteria.
Sporadic incident	An incident involving single or few cases on fewer than five premises; further cases on these premises are prevented by vaccination.
Spore	Inactive, highly resistant form of anthrax found in the environment.
Unusual outbreak	An outbreak involving a number of cases on more than five premises within a defined geographical area in a short period of time.

9.2 Standard AUSVETPLAN terms

Term	Definition
Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hoofs, bones, fertiliser).
Animal Health Committee	A committee whose members are the chief veterinary officers of the Commonwealth, states and territories, along with representatives from the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP) and the Australian Government Department of Agriculture, Water and the Environment. There are also observers from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries. The committee provides advice to the National Biosecurity Committee on animal health matters,

Term	Definition
	focusing on technical issues and regulatory policy. See also National Biosecurity Committee
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved disposal site	A premises that has zero susceptible livestock and has been approved as a disposal site for animal carcasses, or potentially contaminated animal products, wastes or things.
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility that maintains increased biosecurity standards. Such a facility could have animals or animal products introduced from lower-risk premises under a permit for processing to an approved standard.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Water and the Environment who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. See also Chief veterinary officer
AUSVETPLAN	Australian Veterinary Emergency Plan. Nationally agreed resources that guide decision making in the response to emergency animal diseases (EADs). It outlines Australia's preferred approach to responding to EADs of national significance, and supports efficient, effective and coherent responses to these diseases.
Carcase	The body of an animal slaughtered for food.
Carcass	The body of an animal that died in the field.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. See also Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with WOAH guidelines, based on applied biosecurity measures and surveillance, to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. See also Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory chief veterinary officers, representatives of CSIRO-ACDP and the relevant industries, and the Australian Chief Veterinary Officer as chair.

Term	Definition
Control area (CA)	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Cost-sharing arrangements	Arrangements agreed between governments (national and state/territory) and livestock industries for sharing the costs of emergency animal disease responses. See also Compensation, Emergency Animal Disease Response Agreement
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery or milk processing plant (or other such facility) that, after investigation and based on a risk assessment, is considered to contain a susceptible animal(s) not showing clinical signs, but considered highly likely to contain an infected animal(s) and/or contaminated animal products, wastes or things that present an unacceptable risk to the response if the risk is not addressed, and that therefore requires action to address the risk.
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility that, based on a risk assessment, appears highly likely to have received infected animals, or contaminated animal products, wastes or things, and that requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. There are two types of declared areas: restricted area and control area.
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
Disinsectation	The destruction of insect pests, usually with a chemical agent.

Term	Definition
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. See also Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. See also Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. See also Emergency animal disease, Exotic animal disease
Enterprise	See Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. See also Veterinary investigation
Epidemiology	The study of disease in populations and of factors that determine its occurrence.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. See also Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	See Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose

Term	Definition
	preconditions and/or restrictions on movements. See also Special permit
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of a pathogen into an animal and the first clinical signs of the disease.
Index case	The first case of the disease to be diagnosed in a disease outbreak. See also Index property
Index property	The property on which the index case is found. See also Index case
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease is present, or there is a reasonable suspicion that either is present, and that the relevant chief veterinary officer or their delegate has declared to be an infected premises.
Local control centre (LCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.
Modified stamping out	A stamping out policy that is modified – based on risk assessment – to culling only a selected group of animals instead of all susceptible animals that are either infected or exposed to the agent of disease. This modified strategy may be implemented when the destruction of all susceptible animals is not financially or practically feasible. The term 'modified' is used when the stamping out measures are not implemented in full.
Monitoring	Routine collection of data for assessing the health status of a population or the level of contamination of a site for remediation purposes. See also Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National Biosecurity Committee (NBC)	A committee that was formally established under the Intergovernmental Agreement on Biosecurity (IGAB). The IGAB was signed on 13 January 2012, and signatories include all states and territories except Tasmania. The committee provides advice to the Agriculture Senior Officials Committee and the Agriculture Ministers' Forum on national biosecurity issues, and on the IGAB.
National Management Group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture, Water and the Environment as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	See Wild animals

Term	Definition
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Polymerase chain reaction (PCR)	A method of amplifying and analysing DNA sequences that can be used to detect the presence of viral DNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, suspect premises, trace premises, dangerous contact premises or dangerous contact processing facility.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Proof of freedom	Reaching a point following an outbreak and post-outbreak surveillance when freedom from the disease can be claimed with a reasonable level of statistical confidence.
Qualifiers	
– assessed negative	Assessed negative (AN) is a qualifier that may be applied to ARPs, PORs, SPs, TPs, DCPs or DCPFs. The qualifier may be applied following surveillance, epidemiological investigation, and/or laboratory assessment/diagnostic testing and indicates that the premises is assessed as negative at the time of classification.
– sentinels on site	Sentinels on site (SN) is a qualifier that may be applied to IPs and DCPs to indicate that sentinel animals are present on the premises as part of response activities (ie before it can be assessed as an RP).
– vaccinated	The vaccinated (VN) qualifier can be applied in a number of different ways. At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against the EAD in question. However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used to track a range of criteria and parameters.
Quarantine	Legally enforceable requirement that prevents or minimises spread of pests and disease agents by controlling the movement of animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures, and is subject to the procedures and restrictions appropriate to the area in which it is located.

Term	Definition
Restricted area (RA)	A relatively small legally declared area around infected premises and dangerous contact premises that is subject to disease controls, including intense surveillance and movement controls.
Risk enterprise	A defined livestock or related enterprise that is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges and garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. See also Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	The appearance in the blood serum of antibodies (as determined by a serology test) following vaccination or natural exposure to a disease agent.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Slaughter	The humane killing of an animal for meat for human consumption.
Special permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. See also General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. See also Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
State coordination centre (SCC)	The emergency operations centre that directs the disease control operations to be undertaken in a state or territory.

Term	Definition
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease.
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. or An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises (SP)	Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s).
Swill	Also known as 'prohibited pig feed', means material of mammalian origin, or any substance that has come in contact with this material, but does not include: (i) Milk, milk products or milk by-products either of Australian provenance or legally imported for stockfeed use into Australia. (ii) Material containing flesh, bones, blood, offal or mammal carcases which is treated by an approved process.[1] (iii) A carcass or part of a domestic pig, born and raised on the property on which the pig or pigs that are administered the part are held, that is administered for therapeutic purposes in accordance with the written instructions of a veterinary practitioner. (iv) Material used under an individual and defined-period permit issued by a jurisdiction for the purposes of research or baiting. [1] In terms of (ii), approved processes are: 1. rendering in accordance with the 'Australian Standard for the Hygienic Rendering of Animal Products' 2. under jurisdictional permit, cooking processes subject to compliance verification that ensure that a core temperature of at least 100 °C for a minimum of 30 minutes, or equivalent, has been reached. 3. treatment of cooking oil, which has been used for cooking in Australia, in accordance with the 'National Standard for Recycling of Used Cooking Fats and Oils intended for Animal Feeds' 4. under jurisdictional permit, any other nationally agreed process approved by AHC for which an acceptable risk assessment has been undertaken and that is subject to compliance verification.

Term	Definition
	The national definition is a minimum standard. Some jurisdictions have additional conditions for swill feeding that pig producers in those jurisdictions must comply with, over and above the requirements of the national definition.
Swill feeding	Also known as 'feeding prohibited pig feed', it includes: • feeding, or allowing or directing another person to feed, prohibited pig feed to a pig • allowing a pig to have access to prohibited pig feed • the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept • supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig. This definition was endorsed by the Agriculture Ministers' Council through AGMIN OOS 04/2014.
Trace premises (TP)	Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to the disease agent, or contains contaminated animal products, wastes or things, and that requires investigation(s).
Tracing	The process of locating animals, people or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Unknown status premises (UP)	A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.
Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products or a synthetic substitute, which is treated to act as an antigen without inducing the disease.
– adjuvanted	A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).
– attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
– gene deleted	An attenuated or inactivated vaccine in which genes for non-essential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.

Term	Definition
– recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A biological vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A mechanical vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. See also Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
– native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
– feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
– exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
WOAH Terrestrial Code	WOAH Terrestrial animal health code. Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/.
WOAH Terrestrial Manual	WOAH 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.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access/.
Wool	Sheep wool.
Zero susceptible species premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with WOAH guidelines, based on geopolitical and/or physical boundaries and surveillance, to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

10 Abbreviations

10.1 Disease-specific abbreviations

Abbreviation	Full title
ICT	immunochromatographic test
NLIS	National Livestock Identification System
NVD	National Vendor Declaration
PPE	personal protective equipment
VA	vaccination area
WHO	World Health Organization

10.2 Standard AUSVETPLAN abbreviations

Abbreviation	Full title
ACDP	Australian Centre for Disease Preparedness
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
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DCPF	dangerous contact processing facility
EAD	emergency animal disease
EADRA	Emergency Animal Disease Response Agreement
EADRP	Emergency Animal Disease Response Plan
EDTA	ethylenediaminetetraacetic acid (anticoagulant for whole blood)
ELISA	enzyme-linked immunosorbent assay
GP	general permit
IETS	International Embryo Technology Society

Abbreviation	Full title
IP	infected premises
LCC	local control centre
NASOP	nationally agreed standard operating procedure
NMG	National Management Group
OA	outside area
PCR	polymerase chain reaction
POR	premises of relevance
RA	restricted area
RP	resolved premises
SCC	state coordination centre
SP	suspect premises
SpP	special permit
TP	trace premises
UP	unknown status premises
WOAH	World Organisation for Animal Health
ZP	zero susceptible species premises

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