

AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Response strategy

Surra

Version 5.0

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

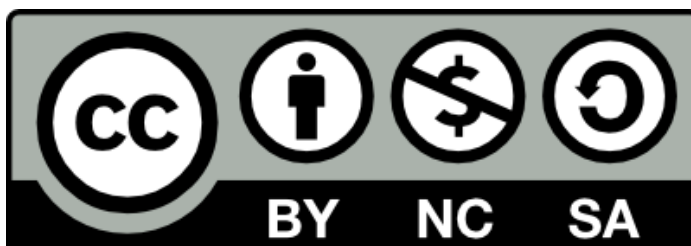
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Edition 3

Version 3.0, 2006, new manual

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Version 5.0, 2021 (incorporation into the Edition 5 format)

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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 surra 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 surra caused by *Trypanosoma evansi*.

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 surra are described in the **Surra Fact Sheet** (Appendix 1).

1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak of surra are based on risk assessment. They are informed by the recommendations in the World Organisation for Animal Health (OIE) *Terrestrial animal health code* (Section 4) and the OIE *Manual of diagnostic tests and vaccines for terrestrial animals* (Part 2). 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 website¹
- 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 – EADRA³), where applicable.

1.3 Training resources

EAD preparedness and response arrangements in Australia

The EAD Foundation Online course⁴ 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

Surra is a haemoparasitic disease transmitted by biting flies. It affects a wide range of host species, causing fever, weight loss, anaemia and a range of other symptoms leading to death in a large proportion of naive animals.

2.1 Aetiology

Surra is caused by *Trypanosoma evansi*, which is one of the salivarian group of trypanosomes. Trypanosomes are parasites occurring in the blood of a large number of wild and domestic hosts. *T. evansi* is a small, actively motile trypanosome, generally about 23–25 µm long. It is morphologically indistinguishable from the slender form of *T. brucei*, and it is thought by some to be a variant of this organism. It multiplies by binary fission. *T. evansi* is found in the blood during the acute stages of the disease, but disappears rapidly after the death of the host (Hoare 1972).

There are antigenic differences between isolates of *T. evansi* because the trypanosome shows variation in its antigen coat. There is limited, equivocal information concerning the existence of strains of *T. evansi* of different pathogenicity (Hoare 1972, Queiroz et al 2000). Some strains are referred to colloquially as ‘highly pathogenic’ but this may be a result of host vector factors, such as stock and insect densities and the susceptibility of host species (Hoare 1972).

2.2 Susceptible species

Surra has a wide host spectrum. The disease is most severe in horses, donkeys, mules, camels, dogs and cats. Disease also occurs in mild or subclinical forms in cattle, alpacas, llamas, and buffalo. Occasional mild, chronic or subclinical disease occurs in sheep, goats, pigs, capybaras and elephants (Hoare 1972). Deer may differ in their susceptibility to infection with *T. evansi*. *T. evansi* is highly pathogenic in *Muntiacus muntjak* (barking deer) (Hoare 1972) and deer in the Philippines (De Jesus 1963), and it induces a chronic disease in *Axis axis* (axis deer) (Hoare 1972) and *Cervus timorensis* (rusa deer) (Reid et al 1999).

Mortality rates are low in cattle and buffalo raised in endemic areas, but movement of animals from Australia (a non-endemic area) to Indonesia (an endemic area) has resulted in high mortality rates (Payne et al 1988, 1991a).

Two species of wallaby commonly found in northern Australia and Papua New Guinea (PNG) — *Macropus agilis* (agile wallaby) and *Thylogale stigmatica* (pademelon) — are known to be susceptible to experimental infection (Reid et al 2001a), but the susceptibility of other species of Australian native fauna to *T. evansi* is unknown. However, dingoes and feral pigs should be considered as potential hosts.

2.2.1 Zoonotic potential

Human infection, despite hundreds of millions of exposures to the infective agent, is not an issue. There is anecdotal evidence of natural infection occurring in humans. Suspected cases of human trypanosomiasis have been reported in one man from Sri Lanka (ProMED-mail 1999) and in two individuals from India (ProMED-mail 2004, ProMED-mail 2005). Confirmation that the infecting

trypanosome was *T. evansi* has only been made in one of the Indian cases (WHO 2005) despite long-term exposure in endemic areas.

2.3 World distribution

For the latest information on the distribution of surra, refer to the World Organisation for Animal Health (OIE) World Animal Health Information System.⁵

2.3.1 Distribution outside Australia

Surra is found over a wide range of climates, but is more common in the tropics. It occurs in a broad band encompassing northern and central Africa (although South Africa is free), the Middle East, Iran, Pakistan, India, Nepal, Southeast Asia, China, and Central and South America (Hoare 1972). In Southeast Asia, it has been reported from Indonesia, the Philippines, Thailand, Laos and Malaysia, but is probably present throughout the region (Luckins 1988, Reid 2002).

Surra is found in most parts of Indonesia, and there is serological evidence of its presence in West Papua (formerly Irian Jaya). Positive serology for *T. evansi* has also been detected in cattle and small ruminants on the border between PNG and Indonesia, but its presence in PNG has not been confirmed (Reid and Copeman 2000).

2.3.2 Occurrence in Australia

Despite buffalo, cattle, banteng and camels being imported from India and Indonesia in the early part of the last century, surra did not become established in Australia. The disease was diagnosed in nine camels imported from India into Port Hedland in 1907, but destruction of the consignment prevented the spread of the disease.

2.4 Epidemiology

2.4.1 Incubation period

The period between initial infection and the onset of clinical signs is extremely variable, but generally ranges between 5 and 60 days — although longer periods (such as 3 months) have been recorded. The interval between infection and the demonstration of parasites in the blood is usually less than 14 days.

Factors that affect the incubation period include the initial infective dose (equivalent to the number of infective insect bites), strain of parasite and stress. In nonclinical cases, the sensitivity of the method used to detect parasitaemia influences the time taken between infection and detection of the parasite.

Although laboratory infections using very large infective doses can produce infective animals after a few days, under field conditions (in which natural infections from biting insects result in much smaller infective doses) it is unlikely that animals would become infective within one week.

⁵ www.oie.int/animal-health-in-the-world/the-world-animal-health-information-system/the-oie-data-system

OIE incubation period

For the purposes of the OIE, the incubation period for surra is 5-60 days.

2.4.2 Persistence of agent and modes of transmission

General properties

T. evansi is a fragile organism that does not survive for long in the environment or after the death of the host (Geering et al 1995). It could persist for short periods on equipment contaminated with fresh blood, but would not be expected to survive once the blood dried.

Environment (including windborne spread)

T. evansi is unlikely to survive outside a live host for more than one day at ambient temperatures in blood or carcasses, and is likely to survive only for hours on animal handling equipment and surfaces at animal handling facilities. Exposure to direct sunlight for 30 minutes is lethal (Holland et al 2001).

Effects of rainfall

Tabanids (eg horseflies, march flies) are widespread and common during the wet season in coastal and subcoastal regions of Australia, but numbers decrease greatly and are focally distributed around permanent water and swamps during the dry season. There is insufficient information to determine whether transmission may be more or less likely during the wet season. Extrapolation from another parasite model (Putra 1991) would suggest that concentration of susceptible animals and tabanids at watering points may favour transmission during the drier months, except on flood plains where animals may be forced to congregate on islands created by floodwater during the wet season.

Windborne vector spread

Tabanids tend to fly upwind in response to host stimuli, reportedly only over distances less than about one kilometer (Foil 1989). Little else is known about windborne spread of tabanids, and there is no information about this characteristic in Australian species.

Live animals

The trypanosomes persist in untreated animals for indeterminate periods, during which time multiple peaks of parasitaemia occur, coinciding with febrile periods. There is little information on the duration of long-term carrier states.

Oral transmission to dogs through the ingestion of infected meat was first shown experimentally in 1907 (Cleland 1907, Raina et al 1985). Oral transmission occurs in vampire bats (Hoare 1972).

Animal products

The fragility of *T. evansi* outside the host means that spread by animal products or biologicals is of no significance. Cryopreserved material is a theoretical risk, but there are no reports of spread by this means.

There is anecdotal evidence of outbreaks in dogs and zoo carnivores fed infected meat (Losos 1986).

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

T. evansi is unlikely to survive in infected meat for more than 8 hours at ambient temperatures (Kraneveld and Djaenoedin 1939). There are no data on the survival of *T. evansi* in chilled meat. However, it is reasonable to expect that survival in chilled meat will not exceed the survival of *T. evansi* in refrigerated blood, which is at least 48 hours (Reid et al 2001b).

Semen and embryos from live susceptible animals

Trypanosoma equiperdum is found in the semen of horses, and Brun et al (1998) and Wang (1988) reported that *T. evansi* could be transmitted directly through coitus. *T. evansi* is routinely cryopreserved in laboratories, and is therefore likely to survive in frozen semen (Holland et al 2001).

The survival of the trypanosome on washed, trypsinised embryos is highly unlikely.

Biological products (eg vaccines)

Live organisms have been recovered from unclotted blood held at 4°C for 48 hours (Reid et al 2001b), although survival at ambient temperatures and exposed to light is only a few hours.

All *T. evansi* organisms were still viable at four hours postmortem in inoculated, parasitaemic rats stored at room temperature; less than 1% were viable at 10 hours (although mice were infected); and by 12 hours all parasites had degenerated (Sarmah 1998).

Equipment, including personal items

As the parasites are in the blood of an infected animal, passage via needles, surgical instruments, dehorning and other such equipment contaminated with fresh infected blood is likely.

Arthropod vectors

The only known means of transmission is mechanical, chiefly by means of biting flies. Tabanids are the most important vectors; stable flies (*Stomoxys calcitrans*) have also been implicated, but not proven. The role of other biting insects, such as mosquitoes and buffalo flies (*Haematobia irritans exigua*), is not known.

Tabanids are the most efficient natural vectors of surra because of their large mouthparts and persistent feeding behaviour. These flies have a large, painful bite, and animals do not usually permit them to complete their blood meal uninterrupted. If the feeding is completed on a single animal, the chance of transmission is reduced, but it is increased if the fly, after interruption, quickly resumes feeding on a nearby uninfected animal (Foil 1989).

The probability of survival of *T. evansi* on the mouthparts of tabanid flies decreases rapidly with time between successive feeds, from 0.5 at less than 15 minutes to 0.04 at 1 hour and 0.0003 at 24 hours (Nieschultz 1927).

Vampire bats may act as both host and vector.

Other relevant considerations

Experimental studies in the United States on the transmission of equine infectious anaemia, a disease that is also transmitted by tabanids, have demonstrated a linear correlation between horse-to-horse distance and the percentage of flies refeeding on the same horse (Issel et al 1988). A separation of 200 metres has been shown to effectively eliminate spread of equine infectious anaemia because of the tendency of flies to complete their blood meal on the original host (Foil 1989).

Little is known about the behaviour of tabanids in Australia, but surra is likely to have an increased prevalence in low-lying timbered areas and near rivers where environmental conditions are favourable for the breeding of insect vectors. Studies on tabanid behaviour in the United States indicate that they breed in or near water, the larvae living in mud or at the bottom of dams, swamps and creeks (Kettle 1984). The adults are active during the day, particularly during hot, sultry weather. Most species will not enter buildings in pursuit of a blood meal, and the rate of attack on horses at pasture decreases with distance from wooded areas.

The level of parasitaemia in individual hosts would also influence the likelihood of transmission.

2.5 Diagnostic criteria

2.5.1 Clinical signs

The severity and course of clinical signs of surra vary according to the virulence of the strain of *T. evansi*, the host species and other stress factors on the animal. Acute and chronic syndromes are seen but may overlap. Immune suppression following surra can lead to a higher susceptibility to intercurrent diseases, which may complicate the clinical picture. Infection can terminate in death, lead to complete recovery, or persist in reservoir hosts. Introduction of the parasite to new areas is characterised by a high prevalence of infection, with mortality reaching 30–100% (Payne et al 1990).

The acute form of the disease may last for up to three months and is characterised by irregular fever, progressive weight loss in the presence of continued good appetite, anaemia, recurrent keratoconjunctivitis and urticarial plaques on the neck and flank, and dependent oedema of the thorax, abdomen, genitalia and legs (Hoare 1972). Increases in body temperature correspond with peaks of parasitaemia.

The clinical signs in chronic cases are less distinctive. Production deficits, lethargy, rough hair coat, progressive emaciation, anaemia, weakness and recurrent fever may be observed. Terminal central nervous system involvement is common

Animals

Horses, donkeys, mules, dogs and cats

In the absence of adequate treatment, surra is often acute and rapidly fatal in horses, donkeys, mules, dogs and cats (Hoare 1972). The course of the acute form of the disease may be as short as 2–3 weeks or as long as four months. Some breeds may also be more tolerant to the trypanosomes than others. There is evidence that donkeys have an extended form of infection and become reservoir hosts (Hoare 1972). Local breeds of horse in Indonesia thrive in endemic areas where introduced thoroughbreds rapidly succumb to infection.

In addition to the typical signs of the acute syndrome described above, petechial (pinpoint) haemorrhages in visible mucous membranes, a wide-based stance, loss of balance and hindlimb proprioceptive deficits (impaired awareness of joint position) may be seen in affected horses (Monzon et al 1990). In South America, the disease in horses is known as mal de caderas ('swaying of the hips') and is characterised by gradual development of central nervous system involvement with weakness, hyperexcitability and incoordination, usually progressing to terminal weakness and paralysis (Hoare 1972).

In dogs, there is marked oedema particularly of the scrotum, ears and neck (Husein et al 1994). Progressive emaciation (despite good appetite), fluctuating fever, enlarged lymph nodes, anaemia and ataxia have also been associated with infection (Husein et al 1994). Corneal opacity may be present. Dogs and cats occasionally exhibit nervous signs suggestive of rabies.

Camelids

In herds of dromedary and Bactrian camels, individual variation in response to infection occurs. Acute syndromes of 2–3 months duration can occur, but the more common chronic form may last up to three years and be associated with wasting, abortion, premature birth, inability to produce milk, and weak newborn calves (Diall et al 1994). If untreated, the disease produces 90% mortality.

Infections in South American camelids such as alpacas and llamas are usually subclinical, although clinical disease has been reported in llamas.

Cattle, buffalo, goats, sheep and deer

In these species, disease is usually less severe. Response to infection can be inapparent, mild or chronic. Appetite is often not affected. Abortion and a sudden drop in milk yield have been reported in buffalo. Death may occur up to six months after the onset of signs, but many animals recover and become reservoir hosts.

Mortality rates are low in cattle and buffalo in endemic areas. However, movement of previously unexposed Australian buffalo into an endemic area in Indonesia has resulted in high mortality in the introduced animals (Payne et al 1991a). Clinical disease has also been seen in previously unexposed cattle.

Emaciation, orchitis (inflammation of the testes) and spermatozoal abnormalities have been reported following experimental infection of goats.

Pigs

Occasional outbreaks of clinical disease have been recorded in pigs. Investigations of livestock losses in a piggery in Indonesia and death and abortion in a piggery in Thailand showed *T. evansi* to be the cause of disease (Kraneveld and Mansjoer 1947, Sirivan et al 1989). Experimental infection of domestic pigs revealed that, after a period of 24–30 days, trypanosomes were rarely detected in blood smears but the blood remained infective to rats (Reid et al 1999).

Rodents and lagomorphs

Rats, mice, guinea-pigs and rabbits are susceptible to infection in the laboratory. The significance of wild populations in the epidemiology of the disease is unknown.

Wildlife and zoo animals

Infection has been reported in a wide variety of wild animals. They include captive tigers and other large felines from India and Sumatra; wolves from Kazakhstan; wild dogs (*Canis azarae*) from South America; foxes (*Vulpes vulpes*, *V. bengalensis*) from Asia; a Sumatran orangutan; deer, tapirs, pikas and capybaras (*Hydrochoerus hydrochaeris*); and vampire bats (*Desmodus rotundus*) from Central and South America.

Capybaras are considered to be important reservoirs of infection in South America, and in Indonesia wild deer and monkeys have been suggested as important reservoir hosts, but the significance of other species in the wild is unknown.

Experimental infection of agile wallabies and pademelons, found in northern Australia and PNG, has demonstrated a high susceptibility to infection. The animals maintained high parasitaemia until death occurred within 30–60 days (Reid et al 2001b). The susceptibility of other species of Australian native fauna to *T. evansi* is unknown.

Humans

There has been only one confirmed case of clinical disease in an immunodeficient human (WHO 2005).

2.5.2 Pathology

Gross lesions

The general pathology of infection with *T. evansi* reflects an active lymphoreticular response by the immune system throughout the body. Gross pathological changes seen at postmortem in animals infected with *T. evansi* vary both between species and between individuals of the same species. In buffalo experimentally infected with *T. evansi*, gross changes included emaciation, serous atrophy of fat, hydropericardium, splenomegaly, lymphadenopathy and active haemopoiesis in the bone marrow (Damayanti et al 1994). The bone marrow is dark red and hyperplastic in acute cases but becomes atrophied, gelatinous and yellowish in chronic cases (Damayanti et al 1994). Gross changes reported in other species include corneal opacity and petechiation of the heart in dogs, congestion of the abomasum and small intestine in camels (Raisinghani et al 1980) and vulval swelling in rabbits (Uche and Jones 1992). Gastric ulceration was reported in horses infected with *T. brucei* (McCully and Neitz 1971) but not in horses infected with *T. evansi*.

Microscopic lesions

The histopathological lesions of surra, especially during early stages of infection, are diagnostic for the disease. Important tissues to examine are choroid plexus, cardiac muscle including the heart valves, lung, spleen and bone marrow. At necropsy, the brain should be sectioned transversely before being placed in fixative to facilitate examination of the choroid plexus and ventricles.

Histological lesions of surra are characterised by hyperplastic changes in the lymph nodes and spleen and lymphocytic infiltration in lungs, kidneys, myocardium, meninges and choroid plexus (Losos and Ikede 1972, Damayanti et al 1994). Trypanosomes may be seen (in sections stained with haematoxylin and eosin) in the interstitium in association with these mononuclear infiltrates, and in blood vessels, appearing as aggregates of small coccoid bodies (nuclear DNA). Such lesions may occur in any organ

with antigen-processing cells but are most consistently found in the choroid plexus (interstitial choroiditis), cardiac muscle (focal nonsuppurative myositis) and lung (diffuse alveolar pneumonitis).

Pathogenesis

The main clinical feature of surra is anaemia. Its pathogenesis is associated with activated macrophages in the spleen, liver, lungs, lymph nodes and bone marrow, which remove red blood cells from the circulation (Murray and Dexter 1988). In addition, macrophages in the bone marrow phagocytose precursor cells, especially those of red cells, platelets, neutrophils and eosinophils (Murray and Dexter 1988). The anaemia is initially responsive before becoming nonresponsive. Peripheral blood has decreased packed-cell volume and red blood cell count, increased lymphocytes, decreased neutrophils and eosinophils, and an initial drop in monocytes followed by normalisation in numbers.

The immune response to infection also results in progressive changes in serum protein levels and particularly increased IgM levels. Increases in the serum enzymes sorbitol dehydrogenase and glutamate pyruvate transaminase may also occur.

2.5.3 Differential diagnosis

The following diseases should be considered in a differential diagnosis of surra:

- African horse sickness
- canine babesiosis
- chronic parasitism
- equine babesiosis
- equine infectious anaemia
- equine viral arteritis
- haemobartonella infection
- purpura haemorrhagica
- *Trypanosoma theileri* (cattle, deer, antelope)
- haemorrhagic septicaemia (cattle)
- malignant catarrhal fever (cattle)
- rabies (dogs).

Trypanosoma theileri is a large trypanosome up to 120 µm long, but its length varies according to the strain of the parasite. It occurs in Australian cattle but has a narrower host range than *T. evansi*, does not infect rodents and is usually nonpathogenic (Bose et al 1987). In blood films and in the HCT, it can be differentiated from *T. evansi*, which is smaller and more motile.

2.5.4 Laboratory tests

Samples required

Tissues required for the diagnosis of surra include:

- whole unclotted blood (with heparin or EDTA)
- dried blood collected using Whatman FTA® cards
- serum

- tissues fixed in formalin:
 - brain (transversely sectioned — see above)
 - cardiac muscle
 - heart valve
 - lung
 - spleen
 - bone marrow.

Transport of specimens

Specimens should be submitted in accordance with agreed state or territory protocols. Specimens should initially be forwarded to the state or territory laboratory for appropriate analysis, and assessment of whether further analysis will be required by the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP), Geelong.

If the state or territory laboratory deems it necessary, duplicate samples of the specimens should be forwarded to CSIRO-ACDP for emergency disease testing, after the necessary clearance has been obtained from the chief veterinary officer (CVO) of the state or territory of the suspect case, and after the CVOs of Victoria and Australia have been informed about the case and the transport of the specimens to Geelong (for the first case). Sample packaging and consignment for delivery to CSIRO-ACDP should be coordinated by the relevant state or territory laboratory.

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

2.5.5 Laboratory diagnosis

Parasitological, serological and molecular tests are available, and augment clinical signs and history in the diagnosis of surra.

CSIRO-ACDP tests

Serological tests

Although serological tests are more sensitive than parasitological tests, they are incompletely standardised for Australian conditions, making interpretation of test results equivocal. There is currently no serological test that can be recommended for use in individual Australian animals that will detect, with useful accuracy, infection or freedom from recent infection with *T. evansi*. Moreover, there is no useful information on the use of such tests in many species of interest, including dogs, pigs, deer, sheep, goats and macropods.

Although not recommended for the detection of recent infections, the card agglutination test (CATT) has some value in identifying longstanding infections, provided that results are interpreted on a herd rather than individual animal basis. After standardisation, its specificity has been determined at 99% in northern Australian cattle (Reid and Copeman 2003). However, the test is not very sensitive for identifying recent infections, as the antigen it is designed to detect may not appear until many months after initial infection, and in some animals may not appear at all.

The antibody-ELISA (enzyme-linked immunosorbent assay) has a better sensitivity than the CATT, reportedly detecting 89% of infected buffalo, but with a slightly lower specificity (92% in cattle and buffalo) (Davison et al 1999). However, antibody-ELISA test results should be interpreted with

caution, particularly on an individual animal basis, and where possible should be augmented with parasitological tests. An antibody-ELISA using a semipurified antigen was shown to have a sensitivity and specificity of 81% and 99.6% respectively when used to test serum from Indonesian cattle infected with *T. evansi* and uninfected cattle from Townsville (Reid and Copeman 2003). This test is being developed in a kit format.

Molecular tests

PCR has been used to detect *T. evansi* in the blood of infected animals and in the blood meal of tabanids (Wuyts et al 1994, Ijaz et al 1998, Holland et al 2001). This work has been extended as part of the ACIAR-funded project AS1/2000/009, and a PCR-based test using primers designed by Wuyts et al (1994) and able to detect 1 trypanosome per mL of blood has been optimised for use with fresh or frozen tissue samples, frozen blood and blood dried onto Whatman FTA cards. Further work is required before this test is fully validated for use in Australia.

Table 2.1. Diagnostic tests for surra currently available in Australia

| Test | Specimen required | Test detects | Time taken to obtain result |
|---|--|-----------------------|-----------------------------|
| Rodent inoculation | EDTA blood ^a | Live <i>T. evansi</i> | 7–30 days |
| Mini-anion exchange centrifugation test | EDTA blood ^a | Live <i>T. evansi</i> | 1 hour |
| Haematocrit centrifugation technique | EDTA blood | Live <i>T. evansi</i> | 30 minutes |
| CATT | Serum | IgM and IgG | 15 minutes |
| Antibody ELISA | Serum | IgG | 4 hours |
| Polymerase chain reaction | EDTA blood, dried blood, fresh or frozen tissues | <i>T. evansi</i> DNA | 4 hours |

CATT = card agglutination test; ELISA = enzyme-linked immunosorbent assay; IgM/IgG = immunoglobulins

^a After collection, blood should be stored at 4°C in a lightproof container and processed within 24 hours. The available information on sensitivity and specificity of tests for *T. evansi* is presented in Appendix 3.

Source: Information provided by Simon Reid, James Cook University, December 1998

Other tests

Parasitological tests

Parasitological tests cannot reliably detect low numbers of trypanosomes in blood. Consequently, they are unable to confirm infection between the periodic peaks of parasitaemia that characterise the chronic phase of surra.

In animals with parasitaemia, buffy coat (white blood cell fraction) can be used in either rodent (mouse) inoculation (RI) or mini-anion exchange centrifugation tests (MAECT), which are able to detect one trypanosome in 2 mL of blood (Reid et al 2001a). These tests are recommended for

diagnostic use in animals during the first few months after infection, when the probability of parasitaemia is highest. Further information on these tests is presented in Table 2.1 and Appendix 3.

The haematocrit centrifuge technique (HCT) is a simple, rapid test that can be performed in the field. Less sensitive than RI tests, it is able to detect approximately 100 *T. evansi* per ml of blood, which can be increased if multiple tubes are examined.

2.6 Resistance and immunity

Innate and passive immunity

Surra is most severe in horses, donkeys, mules, camels, dogs and cats (Hoare 1972). Mortality rates may be high in these species (see Section 2.5.1). However, in Lombok (Indonesia), horses positive by HCT and others with high antibody titres have been observed not to have clinical signs and to be in good condition with a normal packed cell volume (Utami 1996). Trypanotolerance to African animal trypanosomes is recognised in some breeds of domesticated animals. The mechanism is not completely understood, though the trait is heritable (Authié 1994)

Mortality rates are low in cattle and buffalo raised in endemic areas, but movement of animals from Australia (a non-endemic area) to Indonesia (an endemic area) has resulted in high mortality rates (Payne et al 1988, 1991a).

Infection has not been reported in birds or reptiles.

Active immunity

Trypanosomes have multiple genes that code for variable surface-coat glycoproteins (VSGs). The number of different antigenic types of VSGs is unknown for *T. evansi* but there are at least 15 (Jones and McKinnell 1985). Antigenic variation is observed in the host as a fluctuating parasitaemia.

As the trypanosome multiplies in the host, new antigenic variants arise as switching of genes controlling expression of the VSG occurs, giving rise to trypanosomes with a new VSG coat (also known as a variable antigenic type, or VAT) (Van Meirvenne et al 1975, Seed et al 1984). This gene switching produces a mixed population of VATs, with a major VAT and several minor VATs present in the host at the same time. As the major VAT population exceeds the host's immune-recognition threshold, an effective immune response develops and clears those trypanosomes from the blood, allowing the next major VAT to multiply and thus the next wave of parasitaemia to occur (Seed et al 1984).

Animals infected with trypanosomes show immunosuppression, and may succumb to secondary infections (especially early in the course of infection) and fail to respond to vaccines. However, claims for immunosuppression in trypanosomal infections are equivocal, and several authors report conflicting results (Stephen 1986).

Animals treated in the early stages of an initial infection produce only a transient antibody titre. In chronically infected animals, on the other hand, antibodies have been detected for at least four months after use of a trypanocidal drug (Nantulya 1990). Seroconversion to *T. evansi* generally occurs within two to three weeks after infection (Luckins et al 1978).

2.7 Vaccination

The existence of at least 15 VATs in *T. evansi* has, to date, confounded efforts to produce a vaccine.

2.8 Treatment of infected animals

A range of drugs have been recommended for the treatment of surra, but only one — the arsenical drug melarsomine dihydrochloride (Cymelarsan™, Merial) — has been shown to have reasonable efficacy in different host species (Payne et al 1994a). Melarsomine is the only commercially available compound with high efficacy against *T. evansi*. It is currently registered by the Australian Pesticides and Veterinary Medicines Authority only for use in the treatment of canine heartworm in Australia under the trademark Immiticide™. Melarsomine is rapidly absorbed following intramuscular (IM) injection and is cleared from the circulation within six hours. It is also said to cross the blood–brain barrier and, therefore, may be effective in preventing relapses often seen after treatment with other trypanocides (Raynaud et al 1989).

Two factors affect the efficacy of chemotherapy with melarsomine. The first is variation in susceptibility of different isolates, with some isolates requiring up to four times the dose required by others to kill the parasites (Zhang et al 1991). The second is whether the infection is acute or chronic; efficacy of treatment may be reduced in chronically infected animals. Studies in rabbits have demonstrated that relapse of parasitaemia occurs when treatment is given 30 days after infection with *T. evansi* but not in animals treated 15 days after infection (Biswas and Hunter 1993), and treatment of horses experimentally infected with *T. evansi* with 1 mg/kg Cymelarsan did not prevent fatal relapses occurring in one study (Wernery et al 2001).

Melarsomine is well tolerated by domestic animals (although it causes significant pain and inflammation in dogs) and is the only available drug safe to use in horses by IM injection (Wernery et al 2001). The recommended dose of melarsomine (Cymelarsan, Merial) in camels is 0.25 mg/kg by IM injection, and a dose of 0.5– 0.75 mg/kg IM was shown to be effective in cattle in Indonesia (Payne et al 1994ab). The manufacturer recommends that horses be treated with 0.25 mg/kg by IM injection in South America, but the experiences of Wernery et al (2001) suggest that this dose rate is insufficient to effect a cure and that careful monitoring is required after treatment to confirm elimination of the parasite.

3 Implications for Australia

3.1 Potential pathways of introduction

Introduction by hosts

Surra could be introduced to Australia by the import or illegal entry of an inapparently infected animal. It has been postulated that surra was originally spread from Africa to Asia by infected camels used in caravans and military campaigns. Further spread throughout Asia and to South America is thought to have followed export of livestock from India.

Provided appropriate quarantine restrictions are maintained, surra is unlikely to be introduced to Australia by legally imported animals from known endemic areas. Disease in horses, dogs and cats is usually acute and terminal, with a maximum duration of about 90 days. In epidemiological terms, these animals usually play only a short-term role in the spread of the disease. However, horses and dogs that survive a clinical disease episode may become persistently infected and, therefore, pose a quarantine risk. As a wide variety of wild animals and ruminants are effective carriers of trypanosomes, particular attention should be paid to quarantine protocols for zoo animals and camelids from endemic areas.

A possible route of introduction is by the accidental or illegal entry of an infected dog, deer or pig from countries to the north of the Australian mainland. Entry of live animals from the Torres Strait Protected Zone onto the Australian mainland is regulated under Quarantine Proclamation 166A. Ocean-going vessels are inspected by Australian Quarantine and Inspection Service officers to ensure compliance. This risk is also managed by public awareness programs targeting relevant groups in northern Australia (eg Torres Strait communities and schools, primary producer organisations) and by the inclusion of testing for surra in the Northern Australia Quarantine Strategy surveillance program.

Deer are known to swim between the PNG mainland and the northernmost islands in the Torres Strait, but the northern island group and other Torres Strait islands are separated by 35 kilometres. Further southerly spread by dogs and pigs on watercraft within the area is a threat.

Introduction by vectors

Introduction by vectors is not a significant risk because *T. evansi* does not survive very long on the mouthparts of biting flies.

Introduction by animal products, biologicals and genetic material

Introduction by frozen semen or other cryopreserved material is theoretically possible. Other products are unlikely to introduce *T. evansi* because the parasite does not survive long outside the host (See Section 2.4.2)

3.2 Social, economic and environmental effects

Horses, dogs and cats

The diverse nature of the horse industry makes it difficult to determine the social and economic impact that an outbreak of surra and its control would have in Australia. Because Australian horses have not been exposed to the disease, mortality in infected animals and direct economic loss would probably be high if a reliable treatment were not readily available.

During the wet season in northern Australia, when environmental conditions are extremely favourable for the activity of tabanid vectors, disease is likely to be more widespread. Establishment of surra in areas of extensive livestock production would hinder the use of stockhorses to muster cattle and increase property management costs.

Quarantine of an IP could result in severe consequential loss if the premises is a racing stable, stud, agistment farm, equestrian centre, greyhound racing kennel, commercial boarding kennel or cattery, or tourist operation.

If an IP is in a major racehorse training centre, where horses are trained in closely contiguous premises, imposition of movement controls in the RA and CA could suspend racing until treatment is available and epidemiological investigations are completed. Treated horses might not be able to race for some time (the likely detection period for melarsomine in horses is uncertain). As an example of potential losses, total suspension of horse racing in Victoria for one month would affect around 77 race meetings, resulting in losses of almost \$300 million (Racing Victoria, pers comm). There would be additional income loss by a significant number of full-time or part-time employees and by ancillary service providers. These losses would be greater during a major racing carnival. In some areas, the economic effect of a surra outbreak on greyhound racing would also be significant.

Significant but unquantifiable social disruption and economic impact would also result from the probable cancellation of a wide range of other local events at which susceptible host animals are assembled outdoors, such as agricultural and equestrian events, pony and adult riding club rallies, polo/polocrosse tournaments, and rodeos.

The emotional bond between many owners and their companion horses, dogs and cats is such that the social effect of deaths during an outbreak and delays in scheduled exports of dogs and cats would be considerable for individual owners. Deaths of clinically affected horses, dogs and cats, and their destruction for welfare reasons (if a reliable trypanosocidal treatment is not readily available), would result in widespread community concern and media attention.

Cattle and buffalo

There is a lack of objective information on the effect of surra on animal health and productivity in ruminants. In endemic areas, buffalo and cattle are often symptomless carriers of infection (Payne et al 1991b, Coetzer et al 1994), which leads to an assumption that surra does not cause disease in these species. Nevertheless, inapparent infections may cause significant production losses through decreases in milk yield, bodyweight gain and draught power, and increases in calving intervals. Epidemics with significant debility and mortality do occur when the parasite is introduced to new regions or when susceptible animals are imported to endemic areas. A lack of data on the effect of *T. evansi* on productivity in beef and dairy cattle is not sufficient reason to assume that its effect in Australia would be inconsequential, particularly in extensively farmed areas where cattle are subject to intercurrent stress.

The cost of chemotherapy of cattle in extensive areas would be considerable, as it would include not only the cost of the drug but also the cost of mustering. Movement restrictions would cause loss of market opportunities and associated financial losses to nonaffected properties, and to support industries such as the livestock transport industry. This effect may be reduced by zoning and/or chemotherapy of animals before movement.

Exports

Major Australian markets for live horses (such as New Zealand, the European Union, Japan, Singapore, Macau and Hong Kong) are free of surra. Export trade and international horse competitions would be disrupted until new conditions for trade were negotiated with trading partners. Trade in horsemeat contributed approximately \$14 million to Australian export income in 2002–03, with about 40,000 horses slaughtered annually for export (ABARE statistics, 2004). In an Australian outbreak of surra, exports of horses and horsemeat could be jeopardised, albeit with little scientific justification.

While the impact on export trade would be greatest for the horse industry, emerging markets for cattle and sheep in the European Union, Turkey and the Commonwealth of Independent States and for exported dogs and cats would also be affected.

3.3 Critical factors for an Australian response

Three major factors determine the feasibility of controlling surra in Australia:

- the extent of the outbreak before detection
- the location of the outbreak; and
- the species in which it occurs, particularly if feral and Australian native animals are involved.

For example, an outbreak on a southern horse stud would probably be rapidly detected, the movement of dangerous contacts would be known and the potential of the disease to overflow into feral animals would be limited. In such a situation, eradication would be entirely feasible.

However, if surra were first detected on a northern cattle property, initial signs might have been missed and the disease may have become established over a wide area in domestic, wild and feral animals before detection. Eradication in this situation might prove to be uneconomic, in which case efforts would concentrate on regionalising the disease and treating animals in specific cases.

Control could involve confining the disease to one or more regions, regular treatment of animals likely to show severe clinical signs, such as stock horses, and treatment before movement out of the infected region. Tests currently available are not sufficiently reliable to allow movement based only on the results of a negative test.

4 Policy and rationale

4.1 Introduction

4.1.1 Summary of policy

The policy is to eradicate surra where practicable; the initial response to an outbreak should have eradication as its goal.

However, this plan recognises that in some situations eradication will not be a viable option. The disease is insidious in some species, leading to the possibility of infection becoming well established before detection, both spatially and in a variety of wild and domestic species. In these circumstances, the policy is to establish a control program that would slow the spread of the disease and reduce any impact on trade.

A decision on whether to eradicate or control would be based on criteria such as:

- geographical spread
- numbers of domestic animals involved
- level of control over domestic species
- establishment in feral or Australian native animals
- location of the outbreak; and
- effect on trade.

The following strategies are recommended for eradication and control of surra.

Eradication:

- modified stamping out, involving quarantine, and slaughter or treatment with melarsomine of all infected and exposed susceptible animals on the index property; slaughter could include turnoff to abattoirs under controlled conditions
- quarantine and movement controls on animals in declared areas to prevent the spread of infection
- tracing and surveillance to determine the source and extent of the outbreak
- establishment of an animal-free buffer zone around the restricted area
- zoning to define infected and disease-free areas for trade purposes; and
- a public awareness campaign to facilitate cooperation from industry and the community.

Control:

- treatment with melarsomine, where feasible, while the extent of the outbreak is being evaluated; and
- eradication strategies as described above, but with salvage–slaughter at abattoirs.

An uncontrolled outbreak of surra would cause production losses in the beef and dairy industries and an ongoing cost to the horse industry. Costs of control in horses would also affect the beef industry, in which horses are still used extensively to manage stock. The likely impact on Australian native fauna is largely unknown.

4.1.2 Case definition

For the purposes of this manual, a case of surra is defined as laboratory-confirmed infection with *T. evansi* in a susceptible animal with or without clinical signs.

Notes:

- Positive serology in the absence of detection of *T. evansi*, 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.

4.1.3 Cost-sharing arrangement

In Australia, surra is included as a Category 4 emergency animal disease in the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses (EAD Response Agreement – EADRA).⁶ When cost sharing of the eligible response costs of an incident is agreed, Category 4 diseases are those for which costs will be shared 20% by government and 80% by industry.

4.1.4 Criteria for proof of freedom

There are no guidelines in the *OIE Terrestrial Animal Health Code* for proof of freedom from surra. However, active surveillance of the infected zone should be continued for a minimum of one year after the last case, and there must be no trypanocidal treatment of animals in the zone during the 9 months before declaration of freedom. Absence of any evidence of infection over a 3-year period should provide a sound case for declaration of freedom.

In zones where evidence of infection has not been recorded, declaration of zonal freedom from infection is automatic once an effective surveillance scheme is in place.

See Section 7 for further details on criteria that can be used to establish proof of freedom.

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)***.

⁶ 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

Surra has no public health implications.

4.3 Control and eradication policy

There are several principles to be considered in the control and eradication of surra:

- quarantine and isolation of cases and exposed animals
- movement controls and zoning
- effective tracing and surveillance in domesticated and feral populations
- testing of animals before movement out of the infected zone
- treatment of animals
- vector control (tabanids)
- selective depopulation of buffer zones; and
- slaughter of wild or uncontrolled animals.

Although limited outbreaks of surra have been eradicated in Australia and elsewhere, no country is known to have eliminated the disease once it has become well established.

The strategy is to eliminate the disease as quickly as possible by stamping out and other eradication measures, if feasible, in a small well-defined outbreak, or by using treatment and control measures in a less well-defined outbreak. The decision on whether to eradicate or control will be based on criteria such as:

- geographical spread
- numbers of domestic animals involved
- level of control over domestic species
- establishment in feral or Australian native animals
- location of the outbreak; and
- reaction from trading partners.

The action taken will depend on the manner and place in which a diagnosis is made, and on the confidence with which the geographical limit of infection can be assumed.

Clinical cases should either be euthanased immediately or treated with Cymelarsan (melarsomine hydrochloride) and isolated from tabanids by stabling, relocation away from tabanid breeding sites, rugging and application of insect repellent.

In-contact livestock should be treated with melarsomine and isolated from tabanids, or sent to slaughter. Movement to slaughter must be managed to avoid contact with vectors. Travelling animals should be spelled only at night and be slaughtered on the morning of arrival at the abattoir.

See Section 4.3.6 for further details on treatment and Section 4.3.11 for further details on insect control.

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.

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

- the spatial distribution of infected and free animal populations
- potential vectors involved, including as potential amplifying hosts
- 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 initially to determine the feasibility of eradication versus long-term control and 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, and assessment of the progress of disease control 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 Quarantine and movement controls

Surra is not spread by direct contact between susceptible animals. However, quarantine and movement controls on affected and neighbouring properties aid in preventing the spread of *T. evansi* by the movement of diseased animals, and stringent movement restrictions may be implemented immediately the infected area has been identified. Initially, controls on movement and congregation should be imposed on susceptible domestic animals. These may be modified once the situation has been fully investigated.

Quarantine

Confinement of infected or suspect animals within specified limits maintains confidence that spread of the parasite by movement of animals to free areas is not occurring, and allows time for an epidemiological investigation to be undertaken so that more informed control measures can be implemented.

As vector transmission of *T. evansi* is by mechanical means only, and transfer from an infected animal is unlikely over distances greater than 200 metres, the IPs, SPs and immediately neighbouring premises may constitute the restricted area (RA) in the first instance while investigations into the extent of the infection are continuing.

Because vector transmission is limited to about 200 metres, the establishment of an animal-free buffer zone can prevent local spread of infection. This would require the removal from the buffer zone of all susceptible hosts, including domestic, feral and wild animals.

If it is considered that the parasite may be established in reservoir hosts, particularly feral or wild animals, a control area (CA) should be declared immediately. In the early part of the outbreak, the initial CA boundaries may correspond to state borders. The CA boundary can be modified as more information becomes available from investigations.

Movement controls

If chemotherapy is used before movement from the CA, restrictions on treated animals can be less onerous than for nontreated animals, but movement must begin immediately after treatment because the arsenical drugs used for treatment have a period of therapeutic effectiveness of only a few hours.

Introduction of semen and embryos into a CA can minimise disruption to livestock breeding. However, semen from a CA should be regarded as potentially infected and not be allowed out.

Movement controls will be enforced until the status of declared areas can be redefined or until other strategies can be implemented.

Movement of animals out of the RA will be controlled. The movements of wild animals should be considered when determining the boundaries of declared areas.

For further information on declared areas and movement controls, see section 5 and 6.

4.3.3 Tracing and surveillance

Tracing

Trace-back and trace-forward of all direct contacts with infected animals are vital. Tracing should include:

- all domestic and zoo animals;
- fresh meat slaughtered for pet food or for consumption by zoo animals; and
- semen.

Tracing will be used to determine movements of domestic animals susceptible to infection (not only to clinical disease) onto and off the IP during the period from 120 days before the first signs of clinical disease to the introduction of quarantine and movement controls.

It is possible that the first reported case will not be the index case. Trace-back may identify other cases and may establish how the disease entered Australia.

Trace-back and trace-forward periods are influenced by species, season and availability of resources.

Surveillance

Surveillance to determine the extent of an outbreak and to provide confidence that the outbreak has been controlled will vary greatly depending on the species in which the disease is detected and husbandry practices in the area of the outbreak. For example, the type of surveillance established after an outbreak of surra in a southern horse stud would be very different from that needed on a northern extensive cattle property.

Because of the variation in expression of disease between species, surveillance involving horses and dogs should be based on observation of clinical signs, supported by parasitological and serological

testing, whereas in cattle, buffalo and small ruminants greater reliance should be placed on serological testing. Care must be exercised in interpreting the results of serological tests to detect infection in individual animals (see Section 2.5.5).

Where domesticated animals are concerned, each individual on a DCP should be examined and tested. However, when dealing with feral animals adjacent to an IP or DCP, statistically valid sampling to determine freedom is a more practical approach. That vectors are more likely to be active near water sources should be taken into consideration when surveying wild or feral animals. Horses and dogs present on IPs and DCPs will serve as useful sentinels, if examined regularly. See Section 5 for further details.

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,⁷ may be considered.

In the case of a limited disease outbreak, a containment zone⁸ 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 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 OIE guidelines for zoning and compartmentalisation are in Chapters 4.4 and 15.1 of the OIE *Terrestrial animal health code*.

⁷ 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).

⁸ 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.

4.3.5 Vaccination

There is no vaccine available to control surra.

4.3.6 Treatment of infected animals

If eradication of the disease is not possible, treatment of animals diagnosed with the disease is an effective option for control. Although melarsomine is the only drug with high efficacy against *T. evansi* (see Section 2.8), it is not currently registered by the Australian Pesticides and Veterinary Medicines Authority for use in Australia to treat surra. The withholding period for melarsomine is 14 days for milk and meat in camels. There are no data on the withholding period in other species. The likely detection time of melarsomine in racehorses is unknown.

Treatment of clinically affected horses should be carried out on the affected property. On an IP, animals with suspicious signs (eg recurrent fever) should be treated immediately with melarsomine and held during daylight hours in facilities that will reduce biting by tabanids.

Infected animals may be effectively treated with melarsomine. As a risk-reduction measure, treatment, where it can be applied, is equivalent to destruction. Because of the short duration of prophylaxis, treatment timing should be managed with vector exposure strategies to reduce the risk of re-exposure. These strategies could include movement to a vector-free area, biting fly control or cessation of normal husbandry procedures.

Because the half-life of the drug is approximately 6 hours, the duration of effectiveness is only a few hours. All susceptible, exposed animals in a group must therefore be treated simultaneously.

Applying the same treatment strategy on SPs may eliminate the infection before it can be detected by serological or other methods.

Where infection is found in a recently imported horse or its cohort, prompt and simultaneous treatment with melarsomine of susceptible animals, whether infected or not, within a radius of 200 metres is appropriate. Treatment should include animals likely to have been within this radius of the infected animal during the period of illness and since import. The treatment zone may need to be extended depending upon the results of tracing and surveillance.

See Section 2.8 for further details on treatment with melarsomine.

Where treatment is not an option for the owner or is impractical, animals within the zone should be slaughtered. The presence of chronically infected animals would reduce productivity and become an unavoidable financial burden on farming enterprises in the zone.

Movement of susceptible animals outside the zone should not be permitted without treatment.

Routine surgical procedures such as dehorning, castration and vaccination, where there is a risk of transfer of blood between animals on contaminated instruments, should be avoided (see Section 2.4.2). Where husbandry is necessary, instrument decontamination procedures, anti-fly treatments and additional surveillance of stock should be employed.

4.3.7 Treatment of animal products and byproducts

Fresh tissues are considered to be a risk if consumed by a susceptible species. Fresh, unchilled meat from infected carcasses should not be fed to animals within 24 hours of death. Because of the uncertain

survival period of the parasite under chiller conditions, chilled meat or milk should not be fed. Meat must be frozen for at least 72 hours before being fed to carnivores.

Humans are not at risk from surra. There is no risk from processed dairy products, including pasteurised milk, or from wool, other fibres, salted hides or materials that have been rendered.

Trypanosomes would not survive the pasteurisation of milk or freezing of meat.

At room temperature, the parasite does not survive longer than 24 hours after the death of the host animal, but it may survive several days in refrigerated meat. Carnivores can become infected after eating tissues from a freshly killed parasitaemic animal, but normal cooking processes rapidly destroy the organism.

See also Section 2.4.2.

4.3.8 Destruction of animals

All states and territories have the legal authority to destroy infected or suspect animals. However, a decision to destroy all susceptible animals on an IP (stamping out) because of an outbreak of surra would in many cases depend on compensation being available (see Section 4.1). Potentially serious complications of a stamping-out strategy for surra include the high monetary and genetic values of many horses and zoo animals, and emotional distress arising from the bond between companion-animal owners and their horses, dogs and cats. Stamping out might be of value for an index case in a single, recently imported animal.

Although reliable chemotherapy is available, there may be circumstances in which it is appropriate to destroy individual animals (see the **AUSVETPLAN operational manual *Destruction of animals***).

Stamping out

Conventional stamping out (destroying all potential hosts on an infected premises, as opposed to modified stamping out) is not recommended in most outbreaks. It may be an acceptable strategy in an outbreak that is detected early enough and in which all susceptible animals can be destroyed, or where there is confidence that residual hosts do not exist elsewhere.

Modified stamping out involves quarantine and slaughter or treatment with melarsomine of all infected and exposed susceptible animals on the index property. Slaughter could include turnoff to abattoirs under controlled conditions. Valuable animals may be salvaged by treatment (see Section 4.3.6).

4.3.9 Disposal of animals, and animal products and byproducts

T. evansi cannot survive outside a live host for more than about 24 hours, so precautions usually taken when disposing of carcasses or milk from suspect or infected animals may be relaxed accordingly. Care should be taken to deny access by carnivorous mammals to fresh carcasses. Meat taken from infected or suspect carcasses should not be fed uncooked to dogs within 24 hours of the death of the infected or suspect animal.

Fresh blood should be buried or washed away. Hypodermic needles used on infected animals should be burned, buried or disinfected with an approved disinfectant. Appropriate disinfectants are hypochlorites, phenolics, iodophores, quaternary ammonium compounds, acids and alkalis. If medical waste is to be removed from a property for disposal as described in legislation, it should be placed in

prescribed containers, which are then disinfected and placed in plastic bags. The plastic bags are then sealed and disinfected.

Carcases should be buried or secured unrefrigerated in a place where carnivores cannot gain access for at least one day. Infected carcases can be disposed of outside the RA, provided that these precautions are taken.

Animal tissues and blood should be washed from clothing, equipment or vehicles before they are taken from the RA.

Because of the short survival of the parasite outside the host and the low risk of infecting a second host other than by injection, intensive decontamination of an infected property or facilities within the property is not required. *T. evansi* is also rapidly destroyed by heat.

For further information, see the **AUSVETPLAN operational manual *Disposal; Destruction of animals***; and ***Decontamination***.

4.3.10 Decontamination

T. evansi is unlikely to survive for more than a few hours on animal handling equipment or on surfaces at animal handling facilities. Consequently, normal hygienic practices are adequate for the decontamination of premises during an outbreak and to prevent spread by fomites to other properties.

Specific methods of decontamination include heat, disinfectants, burial and washing. Possible treatments applying to various items are in table 4.3.

Table 4.1. Treatments for various risk material

| Risk material | Possible decontamination methods |
|----------------------|---|
| Blood | burial, flushing with water, disinfection, heat |
| Hypodermic needles | disinfection, heat |
| Carcases | heat, burial |
| Vehicles | washing, disinfection |
| Clothing | washing, disinfection |

Given the fragility of *T. evansi*, disinfection with hypochlorites, phenolics, iodophores, quaternary ammonium compounds, acids or alkalis could be expected to rapidly destroy the organism, although specific trials of these compounds on *T. evansi* have not been reported in the literature. It is rapidly destroyed by heat.

4.3.11 Wild animal management

There is no information on the susceptibility of Australian native animals, other than the experimental infection of agile wallabies and pademelons (see Section 2.2). Therefore, if *T. evansi* were to enter an area in northern Australia, wallabies might be a good indicator animal (high mortality in free-living populations could be one of the first signs of an incursion).

The presence of feral animals would pose a serious threat to the control of surra. The wild animals most likely to carry surra are horses, donkeys, cattle, buffalo, camels, dogs, dingoes and pigs. In some circumstances, depopulation of these species may be an option. Other species that could be involved are goats and deer. Rabbits and rodents are unlikely to be important because of their high rate of mortality after infection, and because their nocturnal activity and small size reduce the chance that they will be bitten by tabanids.

The distribution and density of susceptible wild animal hosts need to be determined early in the outbreak. Wild animal populations on IPs and DCPs may be eliminated if considered to be a risk.

Where elimination is decided on, wild pig and wild dog control programs should be instigated or intensified to reduce numbers, and kangaroo/wallaby numbers should be reduced by shooting. Destruction of feral, native and uncontrollable susceptible hosts should be undertaken before mass chemotherapy of domestic animals.

The distribution and movements of feral and Australian native animals should be considered when determining the boundaries of RAs and CAs.

If animal-free buffer zones are created, ongoing depopulation of wild animals will be necessary across a much broader area to ensure that normal home-range movements of wild animals do not include the buffer zone.

For further details on wild animal surveillance and control, refer to the **AUSVETPLAN operational manual *Wild Animal Response Strategy***.

4.3.12 Vector management

Tabanids

No control is used routinely against tabanids in extensive pastoral areas. Regional control might be achieved by insecticidal fogging of vegetation within one kilometre of swamps and other breeding and resting sites, such as densely wooded areas.

Biting of stock by tabanids could be reduced by isolating stock from swampy areas and other tabanid breeding sites, such as densely wooded areas. In addition, insecticidal fogging of vegetation in breeding sites should be considered.

The application of residual synthetic pyrethroids to the host as an insect repellent may assist in reducing the frequency of feeding by tabanids but may have little overall effect on the risk of transmission of *T. evansi*.

Insect traps can also be useful, the most effective being the Manitoba trap (see Appendix 2). However, there is little information on the ecology of Australian tabanids to support this recommendation.

Since tabanids are most active in the middle of the day in sunlight (Coetzer et al 1994), housing animals during the day would offer them protection. Allowing animals to have access to field shelters could also help separate hosts from vectors. Rugs and hoods can also be used to decrease the exposure of horses to insect vectors.

Stable flies

Control of stable flies can be achieved by removing all horse dung from stables and horse paddocks every few days. Stacking the dung in a heap in the sun to promote heating through fermentation will

kill the fly eggs. This is a practical measure in stables and small paddocks but becomes progressively less easy as the size of the paddock increases. Daily application of synthetic pyrethroid to animals and keeping them in stables during the day may also provide an effective deterrent.

Further details on vector control are given in Appendix 2.

4.3.13 Public awareness and media

The industry and the media must be informed that prevailing circumstances will determine very strongly the most appropriate control measures. The rationale for control policies for a vector disease like surra will be more difficult to promote to the horse and livestock industries than previous disease control measures for diseases such as tuberculosis, brucellosis and foot-and-mouth disease, which have used stamping out. The pivotal role of vectors in disease distribution will be the most difficult aspect to convey to the livestock industry.

Public concern may be expressed over the destruction of wildlife and the environmental effects of vector control programs. The media strategy should take these issues into consideration.

Target groups for awareness promotion in a campaign against surra include:

- horse owners/carers — peak racing industry groups, horse councils, equestrian organisations, show societies, importers/exporters
- cattle producers — peak beef and dairy industry groups
- owners of all animals (other than birds and reptiles) and their associations
- wildlife rangers, naturalists and land agents
- residents within affected areas, including Indigenous communities
- veterinary surgeons; and
- the community at large.

Key messages should include:

- surra's long history in endemic areas, which demonstrates that humans are not susceptible to infection
- the importance of reporting and investigating suspect animals, especially within the CA
- the need for cooperation during extended surveillance programs and while movements are restricted
- the means by which the risk of infection can be minimised (eg stabling, application of insect repellent, avoiding congregations of stock, isolating stock from tabanid breeding areas, moving stock by night); and
- why local wildlife populations may need to be destroyed for the sake of the broader wildlife population.

For further information, see the **Biosecurity Public Information Manual**.

4.4 Other control and eradication options

Sentinel and restocking measures

The use of sentinel animals to assess the effectiveness of control/eradication measures for surra will be imperfect because the disease may be present at low prevalence (in wild hosts), or because of

possible fluctuations in the distribution and number of vector insects. Imperfect serological tests may also fail to detect the infection. However, clinical disease could be monitored.

Susceptible horses distributed near tabanid breeding locations during the summer months would provide the best means of monitoring the presence of the agent in residual hosts. Horses should be observed weekly and tested serologically each month with antibody-ELISA.

Sentinel animals may be drawn from local populations, provided they are seronegative, or drawn from free areas. Restocking can start two days after the last susceptible host is treated or removed.

Strategies if the disease becomes established

If surra becomes established in Australia, control efforts will be aimed at controlling the infection within one or more zones to reduce the potential damage to trade, and ensuring that it does not spread outside the zone. If infection is detected outside the established zone, the policy will initially be to eradicate the disease from the new area.

Economically or socially valuable animals within the zone should be treated with Cymelarsan (see Section 4.3.6). Movement of susceptible animals outside the zone should not be permitted without treatment.

4.5 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.⁹ 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***.

⁹ 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 case¹⁰), 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.¹¹ 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

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

During the course of an EAD response, it may become necessary for a CA or RA to be expanded, as additional geographical areas or new foci of infection are identified. Later in the response, as control is achieved, mechanisms for gradually reducing the size of the CA and RA can be introduced.

An EAD may involve multiple foci of infection, with several jurisdictions potentially involved. Since disease might be controlled at different rates in different areas, there may be the opportunity to progressively lift restrictions on an area basis. This would involve reclassifying previously declared

¹⁰ The first case to come to the attention of investigators

¹¹ 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).

areas (RAs and CAs), with a staged approach to lifting of movement restrictions. This is a key step in the recovery process and will have positive benefits on the community.

5.1.1 Restricted area (RA)

An RA is a relatively small legally declared area around IPs and DCPs that is subject disease controls, including intense surveillance and movement controls.

An RA will be a relatively small declared area¹² (compared with a CA) drawn with at least 1 km radius around all IPs and DCPs, and including as many SPs, TPs and DCPFs as practicable. Based on risk assessment, the RA is subject to intense surveillance and movement controls. The purpose of the RA is to minimise the spread of the EAD. The RA does not need to be circular but can have an irregular perimeter, provided that the boundary is initially an appropriate distance from the nearest IP, DCP, DCPF, SP or TP. Multiple RAs may exist within one CA.

The boundaries will be modified as new information becomes available, including from an official surveillance program. The actual distance in any one direction will be determined by factors such as terrain, the pattern of livestock movements, livestock concentrations, the weather (including prevailing winds), the distribution and movements of relevant wild (including feral) animals, and known characteristics of the disease agent. In practice, major geographic features and landmarks, such as rivers, mountains, highways and roads, are frequently used to demarcate the boundaries of the RA. Although it would be convenient to declare the RA on the basis of local government areas, this may not be practical, as such areas can be larger than the particular circumstances require.

5.1.2 Control area (CA)

A CA is a legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity than those in an RA (the limits of a CA and the conditions applying to it can be varied during an incident according to need).

A CA is a disease-free buffer between the RA and the outside area (OA). Specific movement controls and surveillance strategies will be applied within the CA to maintain its disease-free status and prevent spread of the disease into the OA.

An additional purpose of the CA is to control movement of susceptible livestock for as long as is necessary to complete tracing and epidemiological studies, to identify risk factors and forward and backward risk(s).

The CA will be a larger declared area around the RA(s) – initially, possibly as large as the state or territory in which the incident occurs – where restrictions will reduce the risk of disease spreading from the RA(s). The CA will have a minimum radius of 2 km, encompassing the RA(s). It may be defined according to geography, climate and the distribution of relevant wild (including feral) animals. The boundary will be adjusted as confidence about the extent and distribution of the incident increases.

In general, surveillance and movement controls will be less intense in the CA than in the RA, and disease-susceptible animals and their products may be permitted to move under permit within and out of the area.

¹² As defined under relevant jurisdictional legislation

5.2 Other areas

It is possible that other types of areas (eg vaccination area or surveillance area), which are not legally declared, may be used for disease control purposes in some jurisdictions.

5.2.1 Transmission area (TA)

A TA is not a legally declared area but will include all IPs and, where possible, all SPs, TPs, DCPs and DCPFs. In the presence of competent vectors, a TA of 150 km radius should be drawn. The TA does not need to be circular but can have an irregular perimeter, provided that the boundary is initially an appropriate distance from the nearest IP, DCP, DCPF, SP or TP. This distance will depend on the information gained about vector numbers and competence, environmental factors (eg prevailing winds, rainfall, temperature, humidity), and the number and distribution of infected and/or susceptible animals. In the absence of competent vectors, the TA may be reduced in size.

5.3 Premises classifications

Detailed guidelines for classifying premises statuses are provided in the **AUSVETPLAN guidance document *Declared areas and application of premises classifications in an EAD response***, and the definitions are in the Glossary.

5.3.1 Premises status classifications

For surra, the premises classifications to be used are:

- infected premises (IP)
- suspect premises (SP)
- trace premises (TP)
- dangerous contact premises (DCP)
- dangerous contact processing facility (DCPF)
- approved processing facility (APF)
- approved disposal site (ADS)
- at-risk premises (ARP)
- premises of relevance (POR)
- resolved premises (RP)
- unknown status premises (UP)
- zero susceptible species premises (ZP).

5.3.2 Qualifiers

Please also refer to the **AUSVETPLAN guidance document *Declared areas and premises classifications*** for more detail on qualifiers.

For surra, the qualifiers to be used are:

- assessed negative (AN)
- sentinels on site (SN)

- vaccinated (VN).

5.4 Reclassifying premises and previously declared areas

Maintaining movement restrictions on areas for long periods has important implications for resource management, animal welfare, business continuity, and socioeconomic impacts on producers and regional communities. Therefore, attention should be given to reclassifying premises and previously declared areas as quickly as possible.

Detailed guidelines for reclassifying previously declared areas are provided in the **AUSVETPLAN guidance document *Declared areas and application of premises classifications in an EAD response***.

5.4.1 Reclassifying previously declared areas

The lifting of restrictions in declared areas is managed by jurisdictions according to their local legislation, regulations and processes.

The key principles for reclassifying a previously declared area during a response should include the following, noting that not all will be relevant for some diseases:

- The area should be epidemiologically distinct from other declared areas.
- All TPs and SPs have been investigated and reclassified, and all IPs, DCPs and DCPFs in the area have been reclassified as RPs (or APFs).
- All tracing and surveillance associated with EAD control has been completed satisfactorily, with no evidence or suspicion of infection in the area.
- A minimum period of 120 days¹³ has elapsed since predetermined disease control activities and risk assessment were completed on the last IP or DCP in the area or a risk assessment supports reclassification.
- An approved surveillance program (including the use of sentinel animals, if appropriate) has confirmed no evidence of infection in the RA (see below).
- For vector-borne diseases, vector monitoring and absence of transmission studies indicate that vectors are not active.

Lifting of restrictions is a process managed by the relevant CVO under jurisdictional legislation and consistent with the most current agreed Emergency Animal Disease Response Plan (EADRP). When the appropriate conditions are satisfied, an affected jurisdiction can, in consultation with the Consultative Committee on Emergency Animal Diseases (CCEAD), reduce the size of either or both the CA and RA or lift all restrictions as surveillance/monitoring indicates change in risk. The previous part of the RA would then become part of the CA. Jurisdictions should be able to present documented evidence that the appropriate conditions have been met.

When an RA is lifted and becomes part of the CA, it will have a lower risk status, and the movement restrictions that apply will be consistent with those applying within the CA. Over time, all of the RAs will be reduced and lifted.

¹³ The minimum period uses, or is based on, the disease-specific incubation periods defined by the OIE – two incubation periods is a common guideline.

If more than one jurisdiction is affected, each will use its own appropriate legal jurisdictional mechanisms to lift the declaration of the RA or CA, coordinating with each other and consulting with the CCEAD to ensure wide communication and coordination.

After a further period of surveillance and monitoring, and provided that the additional surveillance and monitoring find no evidence of infection, a jurisdiction, in consultation with the CCEAD, could lift the CA. This would result in the lifting of all the remaining regulatory controls associated with the response, and a return to business as usual.

6 Movement controls

6.1 Principles

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

- Containment and eradication of surra is the highest priority. Therefore, 'normal business movements' are not allowed.
- Live animals pose the greatest risk of disease spread; therefore, their movements from all premises within the restricted area (RA) and control area (CA) must be strictly controlled.
- The outside area (OA) should remain as 'clean' as possible. Therefore, movement of animals from the RA to the OA is prohibited, and movement of products is generally prohibited. Movement of animals and products from the CA to the OA will also be restricted.
- Trace premises (TP) and suspect premises (SP) are temporary classifications, and every effort should be made to resolve the status of these premises as soon as possible.
- The numbers of susceptible animals within the RA should be minimised. Therefore, movements of animals into the RA will be limited and usually for slaughter only.
- Movement restrictions are more stringent within the RA than within the CA, and will be more stringent in the early stages of the response.
- Movement controls may be varied during a response from those listed here. However, this will involve a variation to the agreed Emergency Animal Disease Response Plan, with endorsement by the Consultative Committee on Emergency Animal Diseases (CCEAD) and the National Management Group (NMG).
- Recommended movement controls apply to any movement off a premises, whether on foot or by vehicle, that involves either public or private land.
- All movement control matrixes and narratives are for guidance.
- Application for a movement permit does not automatically mean that one will be granted.
- In emergency or exceptional circumstances, any proposed movement may be considered by the jurisdictional chief veterinary officer (CVO) on a risk-assessed case-by-case basis.
- Interstate movements will need to meet the import requirements of the receiving jurisdiction.

6.2 Guidelines for issuing permits

In an emergency animal disease (EAD) event, quarantine and movement controls must strike a balance between quick and effective disease control and business continuity. Therefore, it is not appropriate to simply prohibit all movement of animals and products. On the other hand, diligence needs to be applied to minimise the risk of further spread of the disease.

Recommended biosecurity and movement controls in each AUSVETPLAN response strategy provide guidance on which movements can be allowed and under what conditions. This is based on an analysis of the disease risks that are presented by a specific movement, of a specific commodity, at a specific time during the EAD response phase. Each disease strategy will indicate whether a proposed movement is:

- allowed (under normal jurisdictional, including interstate, requirements)
- prohibited – except under the conditions of a general, special or emergency permit
- prohibited.

Permits may not be available until the relevant CVO provides approval for movements, and this may not be available in the early stages of a response. When assessing risk for the purposes of issuing a permit, the elements to consider may include:

- sources of risk
 - risk material such as live or dead susceptible animals, semen, embryos, meat, meat products, waster products, offal, paunch screenings, manure, render material, fertiliser, biological specimens, casings, used wrappers and cartons, effluent, fomites (vehicle, people, nonsusceptible animals, crops, grains, hay silage and mixed feeds)
 - presence of disease agent on both the originating and destination premises, and uncertainty
 - location of source and destination premises
 - fate at destination premises (eg for slaughter vs for growing out)
 - current vector activity, if relevant
 - organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
 - proposed use of the animals or products
 - proposed transport route
 - vaccination status of the animals, if relevant
 - treatment of animals and vehicles to prevent concurrent movement of vectors, if relevant
 - security of transport
 - security and monitoring at the destination
 - environment and natural events
 - community and human behaviour
 - risk of sabotage
 - technology
 - regulations and standards
 - available resources for compliance and enforcement
- areas of impact
 - livestock health (health of affected species, including animal welfare)
 - human health (including work health and safety)
 - trade and economic impacts (including commercial and legal impacts)
 - environmental impacts
 - organisational capacity
 - political impacts
 - reputation and image
- proposed risk treatment measures
 - vaccination
 - destruction of animals
 - processing of product
 - disinfection or other treatment of animals, vehicles and fomites
 - vector control, if relevant
 - security
 - communication.

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

Table 6.1. Premises

| Movement controls | Infected, dangerous contact and suspect premises |
|--|---|
| <i>Movement out of:</i> | |
| – susceptible animals ^a | Allowed after treatment and permit |
| – animal products and animal byproducts, other than semen and milk | Allowed without restriction |
| – semen | Prohibited |
| – milk | Can be released to an approved facility for pasteurisation |
| – embryos | Allowed without restriction |
| – farm products (eg hay, crops) | Allowed without restriction |
| <i>Movement in and out of:</i> | |
| – people | Allowed without restriction |
| – vehicles | Livestock transport vehicles to be cleaned and sprayed with appropriate insecticide after each journey; other movements in and out allowed without restriction. |

a. For susceptible species, see Section 2.2

Table 6.2. Areas

| Quarantine and movement controls | Restricted area | Control area |
|---|---|---|
| <i>Movement out of:</i> | | |
| – susceptible animals | Controlled by inspection, treatment, application of insect repellent and permit | Controlled by inspection and permit; treatment not usually required |
| – semen | Prohibited | As for RA |
| – milk | Can be released to an approved facility for pasteurisation | As for RA |
| – meat | Can be released after being hung in chiller for three days | As for RA |
| <i>Movement within of:</i> | | |
| – susceptible animals | Controlled by inspection, treatment, application of insect repellent and permit | Controlled by inspection and permit; treatment not usually required |
| <i>Movement through of:</i> | | |

| Quarantine and movement controls | Restricted area | Control area |
|--|--|---|
| - susceptible animals | Controlled by inspection, treatment, application of insect repellent and permit | Controlled by inspection and permit; treatment not usually required |
| <i>Movement in of:</i> | | |
| - susceptible animals | Controlled by inspection, treatment, application of insect repellent and permit | Controlled by inspection and permit; treatment not usually required |
| <i>Movement of susceptible animals from RA to CA:</i> | Controlled by inspection, treatment, application of insect repellent and permit | Not applicable |
| <i>Movement of susceptible animals from CA to RA:</i> | Not applicable | Controlled by inspection and permit; treatment not usually required |
| <i>Any movement of:</i> | | |
| - animal products and animal byproducts (other than meat, semen and milk) | Allowed without restriction | As for RA |
| - people | Allowed without restriction | As for RA |
| - specified equipment | Movement subject to thorough decontamination | As for RA |
| - vehicles | Livestock transport vehicles moving inward and outward must be cleaned out and sprayed with appropriate insecticide after each journey | As for RA |
| <i>Other considerations:</i> | | |
| - risk enterprises | Not applicable | Not applicable |
| - sales, shows or other events where animals from separately managed premises are gathered | For susceptible species, controlled by inspection, treatment, application of insect repellent and permit | |
| - stock routes, rights of way | Not applicable | Not applicable |

7 Surveillance and proof of freedom

As there is currently no OIE Terrestrial Animal Health Code chapter for surra, there are no internationally accepted guidelines on which proof of freedom can be based. The following is suggested as a guide.

Once an incursion of surra has been confirmed, the disease must be made notifiable by law in any state or territory affected (if this is not already the case). A media campaign may be required to ensure that producers, veterinarians, stock agents and others are aware of their responsibilities to report suspicious cases.

7.1 Surveillance

All susceptible domesticated animals on IPs and DCPs should be examined weekly for clinical signs and undergo monthly testing using MAECT and antibody-ELISA for 3 months, followed by quarterly testing for a further 9 months. Where potentially susceptible native or feral animals are on or adjacent to the property, quarterly testing of susceptible domestic animals for longer than 12 months should be considered in the light of results from wild/feral animal surveys.

All other susceptible stock within the RA should be examined as often as is practically possible and be tested using MAECT and antibody-ELISA on a quarterly basis for one year.

Surveys of feral and wild species adjacent to IPs should take place each month for 3 months and then quarterly for at least a further year. Subsequent survey frequency will depend on the results and intensity of earlier surveys. The clustering effects caused by increased vector activity near water sources should be taken into consideration when designing the surveys.

Surveillance of vectors to detect *T. evansi* is appropriate, as PCR tests have proved effective for detecting the parasite in blood meal in the gut of tabanids. Manitoba traps could also be used to identify periods of peak vector activity, which would help determine the timing of serological surveys of susceptible domesticated and wild species.

Although laboratory infections using very large infective doses can produce infective animals after a few days, under field conditions (in which natural infections from biting insects result in much smaller infective doses) it is unlikely that animals would become infective within one week. Seroconversion to *T. evansi* under field conditions generally occurs within 2–3 weeks after infection.

Given that the organism survives for less than a day outside a mammalian host, that seroconversion does not occur until 2–3 weeks after infection and that transmission is by mechanical rather than biological vectors, monthly testing of controlled, domestic animals over a period longer than 3 months is unjustified if the risk of exposure to infected animals has been removed (eg by treatment or by placing them in insect-proof enclosures). However, where uncontrolled hosts such as native or feral animals are potentially present, the period over which domesticated livestock should be under surveillance would be governed by the frequency and intensity of feral animal surveys.

7.1.1 Specific considerations

Serological surveys should be designed to detect at least one seropositive animal with 95% confidence if the true prevalence of the disease is 5% of animals at risk. In view of deficiencies in the sensitivity and specificity of currently available serological tests, it is imperative that the sample size be calculated taking these deficiencies into account if serological screening is attempted. Sample sizes may be large as a result.

For example, if the antibody-ELISA is used for surveying a population of 1000 cattle, given that the sensitivity and specificity are 81% and 99.4% respectively, a sample size of 130 animals would be required.¹⁴ This level of precision (95% confidence of detecting a true prevalence of 5%) may not be achievable when using some of the other serological tests currently available.

Until more reliable serological tests become available, parasitological methods should always be used to confirm serological results. However, it will be necessary to increase the number of animals sampled or to sample on more than one occasion because the sensitivity of parasitological diagnosis is lower. For example, if PCR is used for surveying a population of 1000 cattle, given that estimates of the sensitivity and specificity are 30% and 100% respectively, a sample size of 194 animals would be required to detect a true prevalence of 5% with 95% confidence¹⁵.

Where the number of animals at risk is sufficiently low and laboratory capacity exists, serious consideration should be given to conducting surveys using parasitological methods such as the mini-anion exchange centrifugation test, rather than serological tests.

Details of the published information on sensitivity and specificity of tests for *T. evansi* are given in Appendix 3.

7.2 Proof of freedom

In view of the often insidious nature of this disease, it is unlikely that proof of freedom after an outbreak in which wildlife or feral hosts are involved would be accepted internationally until after a period of three years. In a small, isolated outbreak, where no uncontrolled potential hosts exist, freedom could be achieved within one year.

Seronegative horses should be used as sentinel animals to detect residual infection on an IP where other susceptible animals have either been removed or treated. As the mouthparts of vectors do not remain infective for more than two days and Cymelarsan removes viable *T. evansi* from the blood of treated animals within a few hours of administration, sentinel horses should be introduced three days after removal or treatment of susceptible animals.

¹⁴ Calculated using Survey Toolbox (AusVet Pty Ltd, PO Box 3180, South Brisbane, Queensland 4101)

¹⁵ Calculated using Survey Toolbox.

Appendix 1

SURRA FACT SHEET

Disease and cause

Surra is a haemoparasitic disease caused by *Trypanosoma evansi*, and transmitted by biting flies. It affects a wide range of host species, causing fever, weight loss, anaemia and a range of other symptoms leading to death in a large proportion of naïve animals.

clinical signs of surra vary according to the virulence of the strain of *T. evansi*, the host species and other stress factors on the animal.

Species affected

Surra has a wide host spectrum, and the disease is most severe in horses, donkeys, mules, camels, dogs and cats. Disease also occurs in subclinical or mild forms in cattle, alpacas, llamas and buffalo. Sheep, goats, pigs, capybaras and elephants are susceptible to occasional mild, chronic or subclinical disease.

Two species of wallaby are known to be susceptible to experimental infection, but the susceptibility of other species of Australian native fauna is unknown.

Distribution

Surra is most common in the tropics, but can be found over a wide range of climates. It is known to occur in Africa, the Middle East, Southeast Asia, China, and Central and South America.

Surra is also found in most parts of Indonesia, and positive serology for *T. evansi* has been detected in cattle and small ruminants on the border between Papua New Guinea and Indonesia.

Potential pathways for introduction into Australia

Surra is most likely to be introduced to Australia by the import or illegal entry of an infected animal. It is thought that surra has spread around the globe through the export of infected livestock. Dogs, pigs and deer are also a threat, with many between the island groups of the Torres Strait.

Introduction by vectors is not considered a significant risk because *T. evansi* does not survive long on the mouthparts of biting flies.

Key signs

The acute form of the disease may last for up to three months and is characterised by irregular fever, progressive weight loss, in the presence of good appetite, anaemia, recurrent keratoconjunctivitis, urticarial plaques on the neck and flank, and dependent oedema of the thorax, abdomen, genitalia and legs.

Clinical signs in chronic cases are less distinctive and may include lethargy, rough hair coat, progressive emaciation, anaemia, weakness, and recurrent fever.

Spread

Surra is not spread by direct contact between susceptible animals, but by the spread of *T. evansi*. Movement of diseased animals is the major cause of spread, and so an effective control program would significantly reduce spread.

Persistence

T. evansi does not survive long in the environment or after the death of the host. It is possible for the parasite to persist on equipment contaminated with fresh blood, but not once the blood had dried. Exposure to direct sunlight for 30 minutes is lethal.

T. evansi is unlikely to survive in infected meat for more than 8 hours at ambient temperatures, and there is no data on the survival of *T. evansi* in chilled meat.

Though spread by biting flies, *T. evansi* does not survive long on the mouthpart of biting flies (probability is 0.04 at 1 hour).

Impacts for Australia

An uncontrolled outbreak of surra would cause production losses in the beef and dairy industries and an ongoing cost to the horse industry. Costs of control in horses would also affect the beef industry, in which horses are still used extensively to manage stock. The likely impact on Australian native fauna is largely unknown.

Australian exports would be significantly impacted, and there would be social disruption and economic impact with the probable cancellation of a wide range of events including equestrian and agricultural events.

Appendix 2

PROCEDURES FOR VECTOR MONITORING AND CONTROL

Monitoring

The population of tabanids may be monitored using Manitoba traps (Figure A2.1). The Manitoba trap uses a dark, heat-absorbing body to attract tabanids, which are then directed into a cone in which they are trapped. The addition of small amounts of carbon dioxide around the trap further increases its attractiveness. Traps should use black balls of 70 cm or more diameter and be baited with dry ice (to release CO₂). Trapping is most effective if carried out between 11 am and 2 pm, with the wind blowing towards the suspected breeding site at between 5 and 10 knots. Traps should be placed upwind from the breeding site so that the flies detect the emitted CO₂ and follow it to the trap. Tabanids also shelter in wooded areas near their breeding site, so traps should be located near such areas.

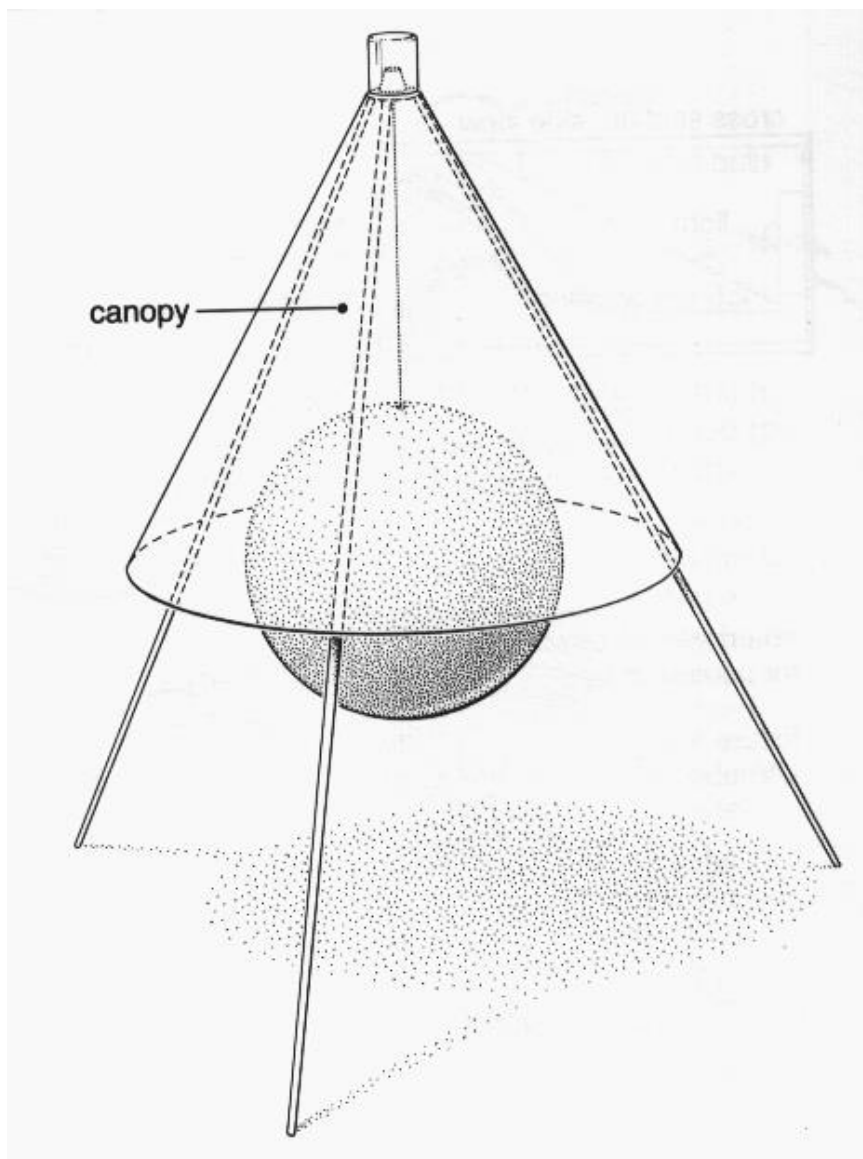


Figure A0.1. Manitoba trap

Control

Insecticidal fogging of tabanid breeding sites and the surrounding area within a radius of one kilometre, especially densely wooded areas, should be undertaken. However, tabanids are strong fliers; although few are caught in traps more than a few hundred metres from their breeding sites, the range of some overseas species can exceed two kilometres (Kettle 1984). Breeding places of the Australian species vary greatly. They include floating vegetation in swamps, mud of rivers and lagoons, damp soil, rotting vegetation, dry or beach sand, and rot holes in the trunks of casuarinas.

Control of stable flies should include insecticidal fogging of the area where animals are kept and daily collection and disposal of horse manure, where this is a practical option.

No data are available on the efficacy of different insecticides against tabanids, but aerial fogging with synthetic pyrethroids at commercially recommended concentrations should be considered as an initial strategy. The frequency of fogging and choice of insecticides should be determined from the results of monitoring activity as outlined above.

Appendix 3

PUBLISHED INFORMATION ON SENSITIVITY AND SPECIFICITY OF TESTS FOR *T. EVANSI*

Table A3.1. *T. evansi* tests

| Test ^a | Horses | | Cattle | | Buffalo | | Camels | |
|------------------------------|--------|------|--------|------|---------|------|--------|------|
| | Sen | Spec | Sen | Spec | Sen | Spec | Sen | Spec |
| Serological tests | | | | | | | | |
| Antibody-ELISA | - | | | | | | 95 | |
| IgG | | 95 | 81 | 99.6 | 89 | 92 | | |
| IgM | | | 30 | 98 | 88 | 55 | | |
| Antigen-ELISA | 63+ | - | - | 68+ | 71 | 75 | 75 | - |
| CATT | - | 100 | 72 | 98 | 78 | 100 | 89 | 100 |
| Suratex | - | - | - | - | - | - | 94 | 100 |
| Parasitological tests | | | | | | | | |
| Direct agglutination | 94 | 97 | - | - | - | - | - | - |
| HCT | 71 | - | 15 | - | 15 | - | - | - |
| RI | 88 | - | 30 | - | - | - | - | - |
| WBF | 46 | - | - | - | 11 | - | - | - |
| MAECT | - | - | - | - | 17 | - | - | - |
| Molecular tests | | | | | | | | |
| PCR | - | - | ~30 | - | - | - | - | - |

^a Definition of and information on each test are given below

Note: Only information from studies with designs considered capable of giving credible results have been included.

Serological tests

Antibody-ELISA — IgM and IgG antibody ELISAs using crude soluble parasite antigen. This is the most accurate of the available serological tests for the detection of recent infection with *T. evansi*. However, improved sensitivity is desirable and there may be scope to achieve this through choice of a better antigen and detection of specific isotypes that recognise the antigen.

Antigen-ELISA — Antigen-capture ELISA using *T. evansi*-specific monoclonal antibody. This test is not worth considering until a reliable source of the monoclonal antibody on which the test is built is secured.

Card agglutination test (CATT) for trypanosomiasis — available from Institute of Tropical Medicine, Laboratory of Serology, Antwerp, Belgium. This test is not recommended for routine use to detect new infection, as it does not become positive until the antigenic type it is designed to detect is

expressed. This may not occur for many months after infection. In addition, conditions under which the test is performed must be carefully standardised in order to achieve repeatable results.

Suratex — commercial monoclonal antibody-based latex agglutination test using monoclonal antibodies from International Livestock Research Institute. There are few data to support claims for this test's sensitivity or specificity, and quality control between batches is suspect. Limited testing of Australian bovine serum gave a specificity of 35% (Reid and Copeman 2003).

Parasitological tests

Haematocrit centrifuge technique (HCT) — the trypanosomes form a layer with the buffy coat (white blood cells) in a haematocrit tube and may be visualised at the interface of the buffy coat and plasma (Woo 1969).

Rodent inoculation (RI) (usually mice) — about 0.25–0.5 mL of blood (or buffy coat from 10 mL of blood) is inoculated intraperitoneally. Blood from the mouse is then checked (usually using tail-tip wet smears) every few days for the next 40–50 days for the presence of trypanosomes. Recent work has shown that this test will detect one *T. evansi* per 2 mL of blood (using buffy coat) (Reid et al 2001b).

Although blood should be inoculated into mice as soon as possible after collection, recent work has shown that the sensitivity of the RI test is not measurably diminished by 21 hours of refrigerated storage (in a lightproof container) of the blood under test (Reid et al 2001b). The use of RI is limited by the practicability of transporting and housing mice in the field.

There is no known difference in susceptibility to infection with *T. evansi* between different strains of laboratory mice. When tested experimentally, infection rates were the same in groups of BALB/c and CBA/CaH mice (Reid and Husein 1998).

Wet blood film (WBF) — a smear of a single drop of blood, examined microscopically for trypanosomes.

Mini-anion exchange centrifugation test (MAECT) — this test involves separation of trypanosomes from approximately 0.2 mL of blood (or buffy coat from 10 mL of blood) with a 2 mL DEAE-cellulose column followed by centrifugation of the eluate and examination of the sediment. Recent work has shown that this test will detect one *T. evansi* per 2 mL of blood (using buffy coat) (Reid et al 2001b).

Molecular tests

Polymerase chain reaction (PCR) — this test has been developed as part of the ACIAR-funded project AS1/200/009 and is suitable for use on fresh or frozen tissues, whole blood (0.25 mL) or blood dried on to Whatman FTA⁰ cards. The sensitivity of this test is comparable to that of RI, and it can also be used to confirm the presence of *T. evansi* in tissue samples post mortem.

Glossary

Standard AUSVETPLAN terms

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| 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, focusing on technical issues and regulatory policy. <i>See also</i> 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. <i>See also</i> Chief veterinary officer |
| AUSVETPLAN | <i>Australian Veterinary Emergency Plan</i> . 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. <i>See also</i> Australian Chief Veterinary Officer |

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| Compartmentalisation | The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with OIE guidelines, based on applied biosecurity measures and surveillance, 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. <i>See also</i> 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. |
| 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. <i>See also</i> Compensation, Emergency Animal Disease Response Agreement |
| Dangerous contact animal | A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation. |
| Dangerous contact premises (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. |

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| Disease agent | A general term for a transmissible organism or other factor that causes an infectious disease. |
| Disease Watch Hotline | 24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888. |
| Disinfectant | A chemical used to destroy disease agents outside a living animal. |
| Disinfection | The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated. |
| Disinsectation | The destruction of insect pests, usually with a chemical agent. |
| Disposal | Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease. |
| Emergency animal disease | A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. <i>See also</i> Endemic animal disease, Exotic animal disease |
| Emergency Animal Disease Response Agreement | Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. <i>See also</i> Compensation, Cost-sharing arrangements |
| Endemic animal disease | A disease affecting animals (which may include humans) that is known to occur in Australia. <i>See also</i> Emergency animal disease, Exotic animal disease |
| Enterprise | <i>See</i> Risk enterprise |
| Enzyme-linked immunosorbent assay (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. <i>See also</i> 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. <i>See also</i> Emergency animal disease, Endemic animal disease |
| Exotic fauna/feral animals | <i>See</i> Wild animals |
| Fomites | Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease |

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| | agent and may spread the disease through mechanical transmission. |
| General permit | A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> 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. <i>See also</i> Index property |
| Index property | The property on which the index case is found. <i>See also</i> 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 | An emergency operations centre responsible for the command and control of field operations in a defined area. |
| Monitoring | Routine collection of data for assessing the health status of a population or the level of contamination of a site for remediation purposes. <i>See also</i> Surveillance |
| Movement control | Restrictions placed on the movement of animals, people and other things to prevent the spread of disease. |
| National Biosecurity Committee | 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 | <i>See</i> Wild animals |

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| OIE Terrestrial Code | OIE <i>Terrestrial animal health code</i> . Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: www.oie.int/international-standard-setting/terrestrial-code/access-online . |
| OIE Terrestrial Manual | OIE <i>Manual of diagnostic tests and vaccines for terrestrial animals</i> . Describes standards for laboratory diagnostic tests, and the production and control of biological products (principally vaccines). The current edition is published on the internet at: www.oie.int/en/standard-setting/terrestrial-manual/access-online . |
| Operational procedures | Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation. |
| Outside area (OA) | The area of Australia outside the declared (control and restricted) areas. |
| Owner | Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer). |
| 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 |

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| | 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. |
| 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. <i>See also</i> Specificity |
| Sentinel animal | Animal of known health status that is monitored to detect the presence of a specific disease agent. |
| Seroconversion | 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. <i>See also</i> General permit |
| Specificity | The proportion of truly negative units that are correctly identified as negative by a test. <i>See also</i> Sensitivity |

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| 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 | The emergency operations centre that directs the disease control operations to be undertaken in a state or territory. |
| Surveillance | A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism. |
| Susceptible animals | Animals that can be infected with a particular disease. |
| Suspect animal | An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted. or An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis. |
| Suspect premises (SP) | Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s). |
| Swill | Also known as 'prohibited pig feed', 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 carcasses 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' |

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| | <p>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.</p> <p>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.</p> |
| Swill feeding | <p>Also known as 'feeding prohibited pig feed', it includes:</p> <ul style="list-style-type: none"> • 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. <p>This definition was endorsed by the Agriculture Ministers' Council through AGMIN OOS 04/2014.</p> |
| Trace premises (TP) | <p>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).</p> |
| Tracing | <p>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.</p> |
| Unknown status premises (UP) | <p>A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.</p> |
| Vaccination | <p>Inoculation of individuals with a vaccine to provide active immunity.</p> |
| Vaccine | <p>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.</p> |
| - adjuvanted | <p>A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).</p> |
| - attenuated | <p>A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.</p> |
| - gene deleted | <p>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.</p> |

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| - inactivated | A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment. |
| - recombinant | A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect. |
| Vector | A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent. |
| Veterinary investigation | An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation |
| Viraemia | The presence of viruses in the blood. |
| Wild animals | |
| - native wildlife | Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials). |
| - feral animals | 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). |
| 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 OIE 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. |

Abbreviations

Standard AUSVETPLAN abbreviations

| Abbreviation | Full title |
|--------------|---|
| ACDP | Australian Centre for Disease Preparedness |
| AN | assessed negative |
| 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 |
| IP | infected premises |
| LCC | local control centre |
| NMG | National Management Group |
| OA | outside area |
| OIE | World Organisation for Animal Health |
| PCR | polymerase chain reaction |
| POR | premises of relevance |
| RA | restricted area |
| RP | resolved premises |
| SCC | state coordination centre |
| SP | suspect premises |

| Abbreviation | Full title |
|---------------------|---------------------------------|
| SpP | special permit |
| TP | trace premises |
| UP | unknown status premises |
| ZP | zero susceptible stock premises |

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