AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

1999

DISEASE STRATEGY FOR AUSTRALIAN BAT LYSSAVIRUS IN DOMESTIC ANIMALS AND CAPTIVE BAT COLONIES

AUSVETPLAN is a response system that provides direction for an Australian approach to an emergency animal disease outbreak. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

Agriculture and Resource Management Council of Australia and New Zealand

This Disease Strategy forms part of:

AUSVETPLAN Edition 2, 1996

[AUSVETPLAN Edition 1 was published in 1991]

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

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Version 2.0 was published August 1999 in electronic format only

Version 2.1, published September 1999 incorporates some minor changes

PREFACE

This **Strategy** for the control of **Australian bat lyssavirus** (ABL), is an integral part of the **Australian Veterinary Emergency Plan**, or AUSVETPLAN (Edition 2). AUSVETPLAN structures and functions are described in the **Summary Document**.

This strategy only applies to ABL–the Rabies AUSVETPLAN currently covers any other lyssavirus. This strategy refers to public health guidelines, developed by health authorities; further information concerning public health must be obtained from those authorities (see references).

This strategy sets out the control principles that were approved by the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) out of session in July 1999, for use in a veterinary emergency caused by Australian bat lyssavirus infection.

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

Document Name, Section no.
For example, **Decontamination Manual, Section 3**.

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

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

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The group was responsible for drafting this strategy. However, the text may have been amended at various stages of the consultation/approval process and the policies expressed in this version do not necessarily represent the views of all members of the group. Contributions may also have been made by other people not listed above and the assistance of all involved is gratefully acknowledged.

CONTENTS

1 NATURE OF THE DISEASE

Between May 1996 and February 1997 a new *Lyssavirus* was isolated on many occasions from three species of fruit bats (megachiroptera) and one species of insectivorous bat in eastern Australia.

The demonstration of pathogenicity in humans through the deaths of two Queensland women in November 1996 and December 1998 as a result of the new lyssavirus infection has led to recommendations for use of rabies vaccine to protect people occupationally exposed to the virus, and as a post exposure treatment for humans bitten or scratched by one of these species (Lyssavirus Expert Group, 1996).

1.1 Aetiology

Clarification of the genotype of the virus is still proceeding, but it is considered to be a new species within the genus lyssavirus most closely related to serotype 1 (classical rabies) and serotype 5 (European bat lyssavirus 1) see Appendix 1. Mice studies at the Centers for Disease Control and Prevention, Atlanta, USA (CDC) have demonstrated that human and animal rabies vaccines are cross-protective against the Australian lyssavirus isolate, now referred to as Australian bat lyssavirus.

1.2 Susceptible species

The Australian bat lyssavirus has been detected from four species of fruit bat (the Black flying fox *Pteropus alecto,* the Little Red flying fox *Pteropus scapulatus,* the Grey-headed flying fox *Pteropus polioencephalus* and the spectacled flying fox *Pteropus conspicillatus*) and one species of insectivorous bat (the yellow-bellied sheath-tail bat *Saccolaimus flaviventris*).

The pathogenicity of the new virus in animals other than mice is currently unknown but studies are underway at the CDC. Further pathogenicity studies are also proposed at the Australian Animal Health Laboratory, Geelong.

1.3 World distribution and occurrence in Australia

1.3.1 World distribution and occurrence in Australia

Rabies in insectivorous bats is widely distributed throughout the United States with 759 cases being reported in 1993. Although sporadic transmission of rabies from bats to terrestrial mammals is known, there is no evidence that bats are a source of enzootic rabies in terrestrial animals (Krebs et al 1994).

A similar epidemiological situation exists among European bats with European bat lyssaviruses (*Lyssavirus* genotypes 5 and 6). The role of bats in Africa, including fruit bats, in maintenance of the various Lyssaviruses present there (*Lyssavirus* genotypes 1, 2, 3 and 4) is less clear (Rupprecht et al 1995).

More details about the distribution of lyssavirus genus apart from the Australian bat lyssavirus is provided in appendix 1.

1.3.2 Occurrence in Australia

From the National Animal Health Information system the following data was available as at August 1997.

Table 1: No. of bats sampled by State/Territory. The number of positives is shown in brackets

State	Fruit bats	Insectivorous bats	Not identified	Total
NSW	94 (9)	26 (0)	2 (0)	122 (9)
NT	14 (1)	8 (0)	0	22 (1)
QLD[1]	299 (18)	399 (4)	30 (0)	728 (22)
SA	0	0	4 (0)	4 (0)
Tas.	0	2 (0)	0	2 (0)
Vic	2 (1)	0	24 (0)	26 (1)
WA	1 (0)	1 (0)	2 (0)	4 (0)
Australia	410 (29)	436 (4)	62 (0)	908 (33)

Table 1 shows the number of bats tested, by State/Territory according to class of bat ó fruit bats (mega bats) or insectivorous bats (micro bats). Queensland reported the highest number of bats tested and the most positives, followed by New South Wales. In all 908 bats have been tested and 33 positives have been found. Seven per cent of the fruit bats and one percent of the insectivorous bats tested were positive. The testing sensitivity reflects the relative numbers in bat populations, Queensland, NSW and Victoria.

There were 748 bats for which identifications were made. In addition there were 22 unidentified mega bats, 72 unidentified micro bats and 66 other bats with no information on class or species. The most commonly tested bats were the bent wing bat (*M. australis*), the black flying fox (*P. alecto*), the grey-headed flying fox (*P. poliocephalus*) and the little red flying fox (*P. scapulatus*). To date positives have only come from 5 species *P. alecto*, *P. poliocephalus*, *P. scapulatus*, *P conspicullatus* and *S. flaviventris*. The bat species so far included in the sampling are shown in Table 2.

[1] More recent figures for Queensland are 755 fruit bats sampled with 40 positive and 819 insectivorous bats sampled with 5 positive. (November 1998)

Table 2: Number of bats sampled by species

NAME	
Mega bats	
Nyctimene robinsoni	Queensland Tube-nosed Bat
Pteropus alecto	Black Flying-fox
Pteropus conspicillatus	Spectacled Flying-fox
Pteropus macrotis	Species found on Torres Strait Islands
Pteropus poliocephalus	Grey-headed Flying-fox
Pteropus scapulatus	Little Red Flying-fox
Micro bats	
Chaerephon jobensis	Northern Mastiff-bat
Chalinolobus gouldii	Gould's Wattled Bat
Eptesicus sp.	
Macroderma gigas	Ghost Bat
Macroglossus minimus	Northern Blossum bat
Miniopterus australis	Little Bent-wing Bat
Miniopterus schreibersii	Common Bent-wing Bat
Mormopterus beccari	Beccari's Mastiff-bat
Mormopterus norfolkensis	Eastern Little Mastiff-bat
Mormopterus planiceps	Little Mastiff-bat
Nyctophilus geoffroyi	Lesser Long-eared Bat
Nyctophilus gouldi	Gould's Long-eared Bat
Nyctophilus sp.	
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat
Scotorepens greyi	Little Broad-nosed Bat
Scotorepens orion	
Scotorepens sp.	
Taphozous australis	North-eastern Sheathtail-bat
Vespadelus darlingtoni	

Isolations have occurred from flying foxes captured as far apart as Darwin (NT) and Melbourne (Vic). It is likely the distribution is even wider than this, and with present knowledge all bats in Australia must be considered potentially infected.

Table 3 Identifying the Common Large Fruit Bats

The large flying foxes or fruit bats are tailless bats having a fox-like face. The first digit on the wing is elongated and has a claw. The second digit also has a claw, which is used as a climbing aid.

The following can be used as a key to identify the common species

1 Upper surface of lower legs thickly furred.....2

Upper surface of legs naked.....3

2 Forearm length over 130mm; rusty yellow fur completely encircling neck; head greyish.....**Grey-headed flying fox (*Pteropus poliocephalus*)**

3 Forearm length over 145mm.....4

Forearm length less than 145mm; reddish brown; light brown-yellow mantle (fur around the neck and shoulders); occasional pale fur around eyes...**Little Red flying fox (*Pteropus scapulatus*)**

4 Prominent creamy-yellow fur around eyes; fur blackish; found coastal north QLD.....**Spectacled flying fox (*Pteropus conspicullatus*)**

No eye rings; fur black with light tips; reddish area of fur on back of neck.....**Black flying fox (*Pteropus alecto*)**

(adapted from Bats of Eastern Australia - Queensland Museum book No. 12)

1.4 Diagnostic criteria

1.4.1 Clinical signs/symptoms

Bats

Affected animals have usually been found on the ground or low in a tree and have been unwilling or unable to fly. When approached affected animals appear either depressed or show abnormal aggressive behaviour. Some animals appear partially paralysed or have a fine tremor. In some, a change of voice has been reported.

Humans

Only two human cases have been recorded with the clinical signs and course of the disease being similar to those of rabies.

1.4.2 Pathology

(See Section 1.4.5 for safety precautions when working with live or dead bats or tissues suspected of being infected with lyssavirus.)

No consistent macroscopic lesions have been seen in infected bats. Their stomachs are usually empty.

Microscopically there is usually non-suppurative meningoencephalitis. The severity and extent of lesions is extremely variable. Most brains have perivascular lymphocytic cuffs, gliosis, meningitis, neuronal degeneration and intracytoplasmic vacuolation. About half the brains have some neurones with intracytoplasmic eosinophilic inclusions consistent with Negri bodies. Non-suppurative myelitis was present in the only spinal cord so far examined. Ganglioneuritis has also been observed.

1.4.3 Laboratory tests

Lyssavirus infection should be excluded whenever a bat is submitted that has bitten or scratched a person.

Lyssavirus infection should be investigated by laboratory examination when an animal has neurological signs, particularly if they include behavioural changes and paralysis, followed by death.

Animal specimens should initially be sent to the State or Territory veterinary diagnostic laboratory from where they may be forwarded to the Australian Animal Health Laboratory (AAHL), Geelong for testing or confirmation of a positive or suspicious test result.

Specimens required/transport

Whole brains collected after death or sacrifice at any stage of the clinical syndrome are required for lyssavirus diagnosis. Severed heads and, for small animals like bats, whole animals, should be forwarded chilled. Animals should not be shot through the head (see Section 1.4.5). Where no brain is available trigeminal ganglion or spinal cord including ganglia, formalin-fixed stomach, intestine and adrenal should be submitted.

Unpreserved and formalin-fixed samples of other tissues should be collected at necropsy to aid differential diagnosis. Whole blood (in EDTA anticoagulant) or serum is required for the RFFIT test (see Table 4). Kidney, liver and stomach contents should be collected for toxicological examination. For further details see Geering *et al* 1995.

Laboratory diagnosis

The tests currently available for the diagnosis of infection by a lyssavirus are shown in Table 4. Results of fluorescent antibody tests are available within 4 hours of receipt at AAHL or a central state diagnostic laboratory. Virus isolation is usually attempted in mouse neuroblastoma cells.

Table 4 Diagnostic tests currently available for lyssavirus infections

Test	Specimen required	Test detects	Time taken to obtain result
Fluorescent antibody test	fresh brain	Virus antigen	4 hours
Histopathology	formalin-fixed brain	characteristic lesions	2 days
Immunoperoxidase staining	formalin-fixed brain	Virus antigen	2 days
Virus isolation using mouse neuroblastoma cells	fresh brain	Live virus	3 days
Polymerase chain reaction	virus or tissue	virus genome	1-2 days
Rapid fluorescent focus inhibition test (RFFIT)	EDTA blood or serum	virus antibody	3 days
Mouse intracerebral inoculation (rarely used)	fresh brain	Live virus	10-28 days

It is necessary to distinguish Australian bat lyssavirus from rabies and other lyssaviruses. Specific polymerase chain reaction primers are available for Australian bat lyssavirus. Sequence comparisons of products using nucleocapsid proteins of known lyssaviruses allow identification of the virus. Identification can also be done using a range of nucleocapsid monoclonal antibodies.

1.4.4 Differential diagnosis

Bats

Clinical signs are so variable that lyssavirus infection should be considered when handling any sick bat. Lead poisoning, parasitic encephalitis and other unknown causes of encephalitis have been identified in bats with nervous signs similar to those seen in lyssavirus affected bats.

Other animals

Infection with Australian bat lyssavirus has not been demonstrated in other native or domestic animals. In the human cases the clinical signs and course of the disease were similar to rabies. Clinical signs of Australian bat lyssavirus infection might look similar to those of any disease causing change of behaviour, depression or ataxia, convulsing or paralysis, ie neurological signs.

1.4.5 Safety precautions

Important: Animals potentially infected with Australian bat lyssavirus should be approached with extreme caution. Affected animals should be captured and confined away from other animals in a stout cage or container. Only experienced bat handlers who have been vaccinated for rabies should attempt to capture and care for sick or injured bats. Caged bats can be euthanased with minimal risk to handlers by enclosing the cage in a plastic bag and dropping chloroform soaked cotton wool into the bag. If the animal can be safely

confined, intravenous or intraperitoneal barbiturate overdose may also be used. If euthanasia must be carried out with a firearm then it is preferable to shoot through the heart as a head shot in small animals makes the brain difficult to process.

Only a pathologist who has been vaccinated for rabies should carry out necropsy. If the necropsy cannot be carried out in a safety cabinet then eye goggles, facemask, thick rubber gloves and overalls or waterproof apron should be worn. Carcasses should be incinerated, and used instruments soaked in disinfectant and then boiled or autoclaved.

1.5 Resistance and immunity

There is little or no information available on natural immunity to bat lyssaviruses.

1.5.1 Innate and passive immunity

Although all warm-blooded animals, including humans, are susceptible to rabies, the degree of susceptibility is by no means uniform.

Once rabies virus infects the brain and clinical signs occur, the disease is almost invariably rapidly fatal. However, on the basis of the finding of naturally occurring rabies antibodies, much presumptive evidence suggests that abortive infections may occur in a proportion of animals in bat populations.

1.5.2 Active immunity

Strains of rabies capable of producing non-fatal and chronic infection of dogs were isolated in Ethiopia in the 1950s and 1970s and similar findings were reported in India. Naturally infected dogs were capable of transmitting fatal disease to humans, in some instances over a period of years. Refer to the **Rabies AUSVETPLAN Manual Section 1.5.1**.

1.5.3 Vaccination

Mice studies at the Centers for Disease Control and Prevention, Atlanta, USA (CDC) have demonstrated that human and animal rabies vaccines are cross-protective against Australian bat lyssavirus.

1.6 Epidemiology

On account of the variability of nervous signs and the relatively high prevalence of infection in bats coming into contact with humans through illness or accident, it is desirable that humans having likely contact with sick bats be prophylactically vaccinated against rabies.

Australian bat lyssavirus infection in domestic animals and animals other than bats has not been demonstrated. If infection does occur it seems likely that clinical signs would mimic rabies.

Forman (1993), writing about classical rabies, stated that:

‘The conclusion from both field observation and antigenic analysis is that rabies viruses tend to be maintained in one host, and that one antigenic type and one host cycle predominate in any geographic area. In countries where urban rabies does not occur, infection of domestic animals or man is a spillover phenomenon and does not normally result in the establishment of a new cycle’.

Although a case of Australian bat lyssavirus infection and/or disease in a domestic animal may occur at any time in eastern Australia, it is considered extremely unlikely, based on the present knowledge of classical rabies and the other lyssavirus genotypes to lead to the establishment of a lyssavirus cycle in carnivores.

1.6.1 Incubation period

There is little or no information available on incubation period of lyssaviruses other than classical rabies. For rabies, the incubation period is generally of the order of 4 to 8 weeks in the natural host, but can vary from 4 days to six months or even longer. Information on incubation period for Australian bat lyssavirus will not be known until experimental infections have been undertaken.

1.6.2 Persistence of agent

There is little or no information available on persistence of lyssaviruses, other than classical rabies.

For classical rabies virus the key features are:

- Rabies virus is comparatively fragile and does not survive for long periods outside the host.
- It remains stable for several months at 0 to 4° C but it is rapidly inactivated by heat, direct sunlight and lipid solvents.
- The virus is stable at pH 5 to 10.
- Infectivity is lost when the virus is treated with proteolytic enzymes; and in saliva in temperate climates it can survive for up to 24 hours.

Environmental contamination, other than aerosol contamination in bat caves, is of very little significance in transmission of rabies virus.

For more information on rabies refer to the **Rabies AUSVETPLAN Manual Section 1.6.2**.

1.6.3 Modes of transmission

Based on overseas and limited Australian experience, it is assumed that lyssaviruses are transmitted by contamination of a fresh wound, usually a bite or scratch (sometimes very small) with infected saliva. Recently, scientists detected lyssavirus in the salivary glands of both *S.flaviventris* and *Pteropus sp*, although it has not been a consistent finding in animals tested to date. There have been recent observations in the United States of human cases without known bites. Aerosol dispersal of infected saliva has been considered a possibility. There have been cases in bat caves in the USA. The small number of cases suggest it is possible, but rare, to get rabies from aerosol. However, further studies are needed to confirm this and exclude other possible modes of transmission.

1.6.4 Factors influencing transmission

There is little or no information available on factors influencing transmission of lyssaviruses. However, the life style of bats is a major factor likely influencing persistence and transmission of lyssavirus. All species of *Pteropus* lead a communal life, spending the day hanging upside down in the upper branches of trees. Often colonies (known as camps) reach up to tens of thousands or even hundreds of thousands bats. At dusk they fly over well-established flyways in search of fruit and flowering trees. In contrast the yellow-bellied

sheath-tailed bat tends to be solitary when roosting, although small groups of two to six have been seen.

2 PRINCIPLES OF CONTROL AND ERADICATION

2.1 Introduction

Control and/or eradication in free living bats of ABLV is not feasible given bats are widespread and a protected species of fauna. Under natural conditions the risk to humans and domestic animals is minimal provided sensible precautions are taken.

Establishment of an endemic infection cycle of ABLV in domestic animals appears unlikely given the natural history of strains of rabies being host specific.

2.2 Methods to prevent spread and eliminate pathogens

2.2.1 Quarantine and movement controls

If the virus were found in a contained captive bat colony, quarantine and movement controls would be applicable. In most situations infected/exposed domestic animals would be euthanased or held under quarantine and observed for at least 3 months.

Zoning
Not applicable.

2.2.2 Tracing

Applicable to captive colonies, or to bats being kept 'under care' by individuals.

2.2.3 Surveillance

Information on the distribution, prevalence, possible serotype/genotype variation and species involved is currently limited. Passive surveillance through submission and laboratory examination of sick bats is to be encouraged to extend our knowledge, and as a sentinel procedure.

2.2.4 Treatment of infected animals

There is no effective treatment for clinically affected animals.

Exposed bats and domestic animals could theoretically be treated with rabies immuno-globulin and post-exposure vaccination. However, this is expensive and rarely likely to be applicable.

2.2.5 Destruction of animals

Only individual infected animals or exposed/suspected infected animals should be euthanased.

2.2.6 Treatment of products and by-products

Not applicable — virus transmission through animal products, by-products and fomites is unlikely to occur.

2.2.7 Disposal

Incineration is recommended after the necessary diagnostic specimens have been taken (refer to the **AUSVETPLAN Disposal Procedures Manual, Sections 3.1 and 3.2**). Burial is recommended where incineration is not available.

2.2.8 Decontamination

The infectivity of Lyssavirus is destroyed by most organic solvents, by oxidising agents, and by surface-active agents (quaternary ammonium compounds, soaps, and detergents). Oxidising agents such as hypochlorite may be used for environmental decontamination and Virkon sachets can be used on inanimate objects and human skin. Quaternary ammonium compounds are useful for personal disinfection.

Should accidental exposure occur as when a person is bitten, when saliva is splashed on the hands or face, or when suspensions containing virus are spilled or splashed, first aid should be applied forthwith to eliminate the pathogen. This includes:

- Immediately scrub the wound thoroughly with soap and water;
- Rapidly applying a disinfectant, either a phenolic, alcoholic, halide or quaternary ammonium compound eg Dettol, alcoholic chlorhexidine, tincture of iodine, Betadine, Milton's solution, Savlon, Cetrimide.

Proper cleansing of the wound is regarded as the single most effective measure for reducing transmission of lyssaviruses.

If the virus is detected or suspected in an animal held or handled in a quarantine centre, laboratory, pound or kennel or household, the areas contaminated by the rabid or suspect animal should be cleaned and disinfected with warm soapy water, and an oxidising agent such as sodium hypochlorite or Virkon or an acid or alkali after the animal has died or been destroyed.

For further details see the **AUSVETPLAN Decontamination Manual, Tables 2.11, 3.12 and 4**.

2.2.9 Vaccination

The ecology and variety of bats in Australia differs considerably from overseas and care needs to be taken in extrapolating overseas findings to Australia. Vaccination policy for people is presented in appendix 2.

Experience overseas

USA

US national policy is that 'immunologically naive domestic animals known to be, or highly suspect to be, exposed to rabies is to either euthanase the animal or put it into 6 months quarantine. US authorities state that there are a small number of published articles supporting that vaccination and immunoglobulin can be effective in preventing clinical rabies in exposed, immunologically naive animals'. There is no registered biologic or protocol for use of such therapy in post-exposure treatment of domestic animals in USA.

Results derived from a study undertaken in Texas indicated that an effective post-exposure rabies prophylaxis for previously unvaccinated domestic animals included an immediate rabies vaccination, with a minimum of 1 booster vaccination, and 90 days strict isolation (Clark and Wilson 1996).

Genotype 1 (classical rabies) is the only type to occur in the USA, although genetic analysis indicates net differences of 15 to 20% between bat and classical rabies viral sequences (Krebs et al 1994).

Europe

The Danish Veterinary Service (where only European bat lyssavirus occurs) advised that they have never done post-exposure treatment of domestic animals that may have been bitten by bats with European bat lyssavirus (EBL). Further, vaccination of dogs is not routinely carried out in Denmark.

A recent report exists of post exposure vaccination being used as a prophylaxis in the Netherlands. However, it does seem that transmission to companion animals does not occur with EBL even in an unvaccinated companion animal community .

South Africa

Africa has not recorded classical rabies in bats. They occasionally record Lagos bat virus and more rarely Duvenhage virus (see Appendix 1). No actions are undertaken to prevent the transmission of these viruses from bats to humans.

All unvaccinated exposed dogs are destroyed. Strict quarantine under supervision for three months may be recommended if the dog has been rabies vaccinated. The high expense and detailed program required for post-exposure rabies immunoglobulin and vaccine precludes this approach, although the key issue still remains whether this approach may only suppress or delay symptoms or whether it could be effective in eliminating rabies infection.

2.2.10 Wild animal control

No transmission to carnivores is apparent with ABL. Bats are protected and widespread. Controls are not recommended unless a sylvatic cycle became established. Then, overseas experience with wild life vaccination suggests oral vaccination using modified rabies virus baits would be the preferred approach to ABL control in wildlife.

2.2.11 Vector control

Not applicable

2.2.12 Public awareness

The isolation of Australian bat lyssavirus has already received wide coverage. Further information is available from the Commonwealth Department of Health and Family Services or State health departments (see appendix 2).

2.3 Feasibility of control in Australia

ABL is endemic in Australian bats. Any control of transmission of infection to humans has to be based on reducing people's exposure to bats.

3 POLICY AND RATIONALE

3.1 Overall policy for Lyssavirus

The preferred policy for Australian bat lyssavirus infections **in respect of DOMESTIC ANIMALS** is as follows:

3.1.1 Current situation, with no known natural infection of other animals:

- **Monitoring for Australian bat lyssavirus in domestic animals is included in clinical surveillance for animals showing signs of rabies-like illness. For further details see the Rabies manual, Section 1.4.4 and 1.4.5.**
- **Where feasible, lyssavirus infection should be excluded from bats incriminated in close contact exposure to domestic animals (unless domestic animals are proven to be refractory to the virus).**
- **Domestic animals bitten or scratched by bats found to be infected with the Australian bat lyssavirus, should either be:**

  kept under strict home detention for a period of three months with exposure only to people who have been vaccinated for rabies and with monthly veterinary examination, or;

  kept in government approved quarantine facilities for three months at the owner's expense;

  or;

  destroyed.
- **Vaccination of domestic animals, post-exposure, is not recommended. (However, see Section 3.2.5.)**
- **For domestic animals considered possibly exposed, owners should be advised to closely monitor the animal's behaviour and report any suspicions immediately. Advise owners to take sensible precautions**.

3.1.2 If lyssavirus is confirmed by post mortem in a domestic animal:

- **Isolate and monitor any in-contact animals and destroy any in-contact animals that develop suspicious clinical signs and submit them for post-mortem examination at an approved laboratory.**
- **Provide a public information campaign. Include information that an isolated case does not mean the virus is cycling in the domestic animal population. Additional actions will however be taken to eliminate the possibility of further transmission. Request people to report suspicious cases promptly to their private veterinarian, government veterinarian, or disease watch hotline.**
- **Post-exposure prophylactic procedures as advised by the Health authority should be undertaken by any persons thought to have been exposed to the case.**
- **Increase (if necessary) the control of stray carnivores (foxes and cats) in the immediate vicinity.**
- **Maintain a surveillance program in the area, primarily by keeping local veterinary practitioners, council dog control officers, pound officers, RSPCA inspectors, and police well informed and asking them to report immediately any suspicious clinical cases.**

3.1.3 Overall policy for exposure of people to bats

Given the current state of knowledge about the Australian bat lyssavirus, the following recommendations are made:

Currently, the case for routine vaccination of captive bats or other animal species with rabies vaccine in Australia is not yet established and cannot be recommended.

The general public should be advised not to handle bats.

Bat carers and people occupationally exposed to bats should be vaccinated, use protective equipment and avoid bites and scratches from bats.

Strictly limit direct access to captive bat colonies to trained, vaccinated people.

- **The risk of lyssavirus infection in captive bat colonies can be reduced by serial blood testing of flying foxes to establish serological freedom and isolation of the colony from all other bats.**
- **Cavers and other people frequenting enclosed areas occupied by captive bats should receive rabies vaccination.**

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

3.2 Strategy for control and eradication

3.2.1 Stamping out

Not applicable.

3.2.2 Quarantine and movement controls

If lyssavirus is diagnosed in any domestic animal or captive bat, the premises should be quarantined and movement of potentially exposed animals restricted.

3.2.3 Treatment of infected animals

Post exposure treatment using vaccine and immunoglobulins is not routinely practised anywhere else in the world. The only justification could be for an extremely valuable animal.

A regime suggested by the Directorate of Veterinary Services, South Africa is administration of vaccine (double dose) and immunoglobulin on day 0, and then follow-up with further single doses of vaccine on days 3, 7, 14, 28 and 90.

3.2.4 Treatment of animal products and by-products

Lyssaviruses are fragile outside the host and are not viable for long. Environmental contamination is of very little significance. Fruit, unless handled immediately after being exposed to an infected bat's saliva, is safe. All eatable fruit should be washed as standard practice.

3.2.5 Vaccination

The following issues were considered in developing the policy on the use of rabies vaccine in animals associated with Australian bat lyssavirus infection:

- The use of rabies vaccine in domestic small animals directly exposed to potential infection through bites and scratches from bats.
- The use of rabies vaccination in permanent captive colonies of bats, particularly those in collections open to the public.
- The implication of such vaccine use for Australia is continuing rabies-free status under OIE definitions.
- The conditions governing distribution and administration of rabies vaccine, if approved for use in animals.

Vaccination of domestic animals

The susceptibility of other, particularly domestic, animals to clinical disease resulting from Australian bat lyssavirus infection is currently not known. Experience with related but not identical bat viruses overseas suggest that transmission of virus to other animal species sufficient to cause clinical disease is very unlikely. On the other hand, the international implications of even dead-end clinical cases in wild or domestic dogs or cats in Australia could be significant.

Exposure of domestic animals through bites and scratches from sick and ailing bats is certain to occur. Post exposure rabies vaccination in such cases, (particularly if the particular bat was demonstrated to be infected), could be considered in the light of such implications. Any such limited use of vaccination would be with CVO approval and under supervision.

Widespread use of vaccine would be counterproductive to surveillance, which is the primary thrust of the policy. If Australia vaccinates in-contact animals and they do not get sick, we will not know whether this is because the vaccine has worked or because an exposure with an infective dose has not occurred or because ABL virus cannot infect other animals. Widespread vaccination will confuse interpretation of diagnostic tests.

Vaccination of permanent captive bat colonies

Recommendations have been made and advice issued concerning the need for the public to avoid handling of bats, and for veterinarians, bat carers, zoo staff and other occupationally exposed people to take considerable care in the handling of sick animals. Prophylactic vaccination of a range of people has been recommended and implemented.

There are a number of captive populations of bats/flying foxes in zoos and wildlife sanctuaries, in respect of which some handling and direct human contact will be regularly necessary.[2] Vaccination of such permanent captive animal groups may be a mechanism to reduce risks to handlers and the visiting public, irrespective of whether such risks are real or perceived. Although vaccination of handlers may be an option, this would not be an alternative to vaccination of the colony in respect to short-term exposures arising from visits by tourists and the general public.

While vaccination of bats would probably be successful it is not known what effect this would have on pre-existing infections. It may stimulate pressure for vaccination to be made more widely available to bats in care and to other animal species.

It seems prudent to ensure that access to captive bat colonies is strictly limited to vaccinated personnel and to reinforce the warning that handling of bats by the general public should be avoided.

The implications to Australia's rabies free status from widespread use of rabies vaccine for lyssavirus

The OIE International Animal Health Code, as amended, (OIE Code) defines a rabies free country as follows:

A country may be considered free from rabies when:

(1) the disease is compulsorily notifiable;

(2) an effective system of disease surveillance is in operation;

(3) all regulatory measures for the prevention and control of rabies have been implemented including effective importation procedures;

(4) no case of indigenously acquired rabies infection has been confirmed in man or any animal species during the past two years; however, this status would not be affected by the isolation of a European Bat Lyssavirus (EBL1 or EBL2);

(5) no imported case in carnivora has been confirmed outside a quarantine station for the past six months.

A number of issues for Australia arise from this definition in relation to lyssavirus infection in Australia. The OIE Code only recognises bat lyssaviruses EBL1 and EBL2 as not necessarily being rabies virus. The Australian bat lyssavirus would appear to constitute a distinct genotype, and international recognition of the status of the Australian type as one that, like the European types, should not affect classical rabies free status, is being pursued as a priority.

The rabies free status of a country, according to the OIE Code definition, is not affected by the controlled use of rabies vaccine in animals in that country. If a policy approving vaccine use was agreed, this should have no impact on Australia's continuing rabies free status particularly where that use is not in carnivores. Of particular significance is the fact that the vaccine would be used not to specifically prevent classical rabies disease, but purely for its cross-protection against Australian bat lyssavirus induced disease. However, any routine vaccination of dogs and cats may have quarantine implications in that imports into a country

[2] There are also people with permits to handle bats and volunteer bat carers

such as New Zealand may face import restrictions because such vaccination could imply that Australia is no longer a rabies-free country.

From an examination of the OIE requirements for rabies free countries, there would not appear to be an impediment to the limited controlled use of rabies vaccine in animals, under the circumstances discussed above.

Conditions for use of rabies vaccine

Any policy (other than that required for export reasons) on the use of rabies vaccine in animals associated with bat lyssavirus infection must incorporate high level controls over vaccine distribution and usage.

Currently, animal rabies vaccine[3] is imported specifically for use in dogs and cats for export, to meet importing country requirements. The import permit specifies that the vaccine must be administered to animals only under conditions approved by the Chief Quarantine Officer (Animals) (CQO[A]). In view of the transfer of quarantine operational responsibilities in most States to the Commonwealth, which has occurred subsequently to the setting of the existing import conditions, this import condition requires review. Conditions governing the use of rabies vaccine (for animal use) are expected to be amended to those approved by the State Chief Veterinary Officers.

AUSVETPLAN strategy for classical rabies

The AUSVETPLAN disease strategy for **rabies** is that when a rabid animal is discovered, every effort is made to locate all animals that were exposed to it so that they may be either destroyed, or vaccinated and quarantined. Stray animals are to be impounded, ownerless ones destroyed and all others kept under secure restraint. A compulsory mass vaccination program of all domesticated carnivores in designated areas would be instituted. Thus Australia's overall policy is to eradicate rabies quickly for public health reasons and to prevent spread to both domestic and wild animals.

3.2.6 Tracing and surveillance

Any bat, which bites a person or domestic animal, should be tested for ABL infection.

All domestic animals bitten by the affected bat in the previous seven days or during clinical signs should be traced and placed under quarantine and surveillance.

Following diagnosis in a domestic animal, heightened bat surveillance maybe warranted.

3.2.7 Decontamination

A high level of hygiene and safety measures for personnel are required in the handling of infected and suspected animals. Contamination with aerosols and saliva is a possibility and all personnel associated with handling animals and parts of animals must take all necessary precautions such as the use of gloves, masks and eye protection.

[3] Two vaccines, 'Trimune'; Fort Dodge Laboratories [importer CSL] and 'NobiVac', Intervet, Netherlands [importer Intervet Australia Ltd] have been approved by AQIS for use in Australia on export animals under CQO (A) control, and would be available for emergency use within Australia. An emergency use permit has been issued by the NRA. Three other vaccines, are currently being processed for approval for use in Australia under State chief veterinary officer control. (None of these vaccines have undergone complete assessment necessary for unrestricted (commercial) distribution).

Examination areas must be washed using soapy water and disinfected (eg by use of an oxidising agent) and kept clean and hands and clothing washed and disinfected.

For more information refer to the **AUSVETPLAN Decontamination Manual, Table 2.11**.

3.2.8 Wild animal control

Destruction of wild bats or their habitat is not warranted (see section 2.2.10).

3.2.9 Media and Public relations

The public must be kept informed but the risk also put into perspective. In close consultation with health authorities, keep providing the known facts and precautions to be taken when handling bats and suspect/exposed animals (see appendix 2).

3.3 Social and economic effects

Handled properly the occurrence of ABL virus in Australia should have minimal social effect and economic impact.

3.4 Criteria for proof of freedom

Testing of bats to date has demonstrated that the virus in bats is widely distributed. To establish freedom from Australian bat lyssavirus would require an extensive prolonged sampling program of a wide range of bat species, following an extensive eradication campaign based on oral vaccination by baiting programs.

3.5 Funding and compensation

Rabies is included in the Commonwealth/States cost-sharing agreement for the eradication of certain exotic animal diseases. ABL **could** be covered if the Consultative Committee, considered that the case or outbreak clinically appeared to be rabies and agreed that eradication of the disease from domestic or captive animals, in accordance with this strategy, is possible or appropriate. Otherwise operational funding would come from State resources.

3.6 Strategies if the disease becomes established

ABL infection is established in the Australian bat population across a wide area of Australia.

In the unlikely event that ABL established a cycle in domestic or wild terrestrial animals, vaccination strategies would be implemented. (Refer to the **Rabies AUSVETPLAN Manual Section 3.6**)

Appendix 1 Other recognised members of *Lyssavirus* genus

The lyssavirus genus of the family Rhabdoviridae consists of five serotypes. The viruses within the genus share serologic relationships, but the serotypes and stable species associated variants within serotypes can be distinguished by the reactivity profiles of monoclonal antibodies (Mab). Analysis of the nucleotide sequence of the nucleoprotein gene has also shown genetic clusters along the same lines as serologic analysis, except that serotype 5 has been separated into two genotypes.

Lyssavirus	**Serotype (Genotype)**	**Reservoir**
Classical rabies virus	Serotype 1 (Genotype 1)	Found worldwide, except for a few island nations, Australia, and Antarctica. Endemic and sometimes epidemic in a wide variety of mammalian species, including bats. >25,000 human cases/year almost all in areas of uncontrolled domestic dog rabies.
Lagos bat	Serotype 2 (Genotype 2)	Unknown, but probably fruit bats. Ten cases identified as at December 1995, including three in domestic animals, in Nigeria, South Africa, Zimbabwe, Central African Republic, Senegal and Ethiopia. No known human cases.
Mokola	Serotype 3 (Genotype 3)	Reservoir unknown but probably an insectivore or rodent species. Occurs in Africa. Seventeen cases known including nine domestic animals and two human cases.
Duvenhage	Serotype 4 (Genotype 4)	Reservoir unknown but probably insectivorous bats. Occurs in Africa. Four cases known, including one human death. No cases in domestic animals.
European bat Lyssavirus	Serotype 5 (EBLV1 and EBLV2 genotypes) (Genotype 5– EBLV1, Genotype 6– EBLV2)	European insectivorous bats. More than 400 cases recorded in bats, and a few human cases. No known domestic animal cases.

Appendix 2 Preventive Measures for People

Recommendations from the Department of Health and Aged Care

PREVENTIVE MEASURES

Assume that ALL Australian bats have the potential to carry the new lyssavirus. The best protection against being exposed to the virus is to avoid handling bats. If you must handle bats, observe these safety precautions.

1. **Handling bats**: Before handling a bat, give some thought to whether you really do need to handle the animal. There maybe alternatives such as simply covering a sick or injured animal. If you must handle a bat, make every effort to avoid being bitten or scratched.

2. **Vaccination**: Get vaccinated. A safe vaccine is readily available. It requires a course of injections over a month.

3. **Protective clothing**: Wear puncture-proof gloves, long sleeves, protective glasses and mask. Cover existing cuts, scratches and sores. Lyssaviruses are known to have been transmitted through open wounds (bites, sores etc), and through mucus membranes (eg eyes, mouth). Bats can easily bite through cloth or leather gloves, so you will still need to avoid being bitten as much as possible. You might consider wearing chain mail gloves.

4. **Blood and saliva**: Avoid direct contact with the blood and saliva of bats. Note that simply touching animals or coming into contract with their urine or faeces will not transmit other closely related lyssaviruses.

5. **Bites, scratches and other exposures**: If bitten or scratched, immediately scrub the wound thoroughly with soap and water. Proper cleansing of the wound is regarded as the single most effective measure for reducing transmission of lyssavirus. If you get bat blood or saliva in your eyes, nose or mouth, you should flush the area thoroughly with water. In all cases you should then seek medical advice immediately even if you have been vaccinated. Where possible, without placing other persons at risk or exposure, the bat should be kept and submitted through the State agricultural department for further investigation by the State veterinary laboratory.

If you are able to keep the bat for testing, it should be kept alive if possible. Only wildlife authorities, State Agricultural departments and authorised veterinarians are permitted to kill bats.

For further information, you should contact the health or agriculture department in your State.

VACCINATION

The Australian bat lyssavirus is closely related to classic rabies virus, and animal studies indicate that infection may be prevented by rabies vaccine and rabies immunoglobulin. Recommendations for administering these are provided below.

PRE-EXPOSURE VACCINATION

Pre-exposure vaccination is recommended if you have never been bitten by a bat, and are occupationally or recreationally exposed to bats, where there is a risk of being bitten or scratched; for example:

- Bat carers, bat banders, researchers and students
- Veterinarians
- Wildlife Officers (including local government officers)
- Veterinary laboratory staff
- Managers of display or research colonies of bats
- Members of indigenous communities who may catch bats for consumption
- Power line workers who frequently remove bats from power lines.

You should see your doctor about the need for vaccination if you are in one of these groups.

POST EXPOSURE VACCINATION
(If you are bitten or scratched by a bat, or get bat blood or saliva in your eyes, nose or mouth)

If you are injured (eg bitten or scratched by a bat) the wound should be washed thoroughly as soon as possible with soap and water, and then immediately seek medical advice. You may need booster vaccinations. Proper cleansing of the wound is the single most effective measure for reducing transmission of lyssaviruses. If you get bat blood or saliva in your eyes, nose or mouth, you should flush the area thoroughly with water and then immediately seek medical advice, even if you have been vaccinated.

(Issued by the Department of Health and Aged Care, October 1998)

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GLOSSARY

Animal by-products	Products of animal origin destined for industrial use, eg raw hides and skins, fur, wool, hair, feathers, hooves, bones, fertiliser.
Animal products	Meat products and products of animal origin (eg eggs, milk) for human consumption or for use in animal feeding.
AUSVETPLAN	A series of documents that describe the Australian response to emergency animal diseases, linking policy, strategies, implementation, coordination and counter-disaster plans.
Consultative Committee on Emergency Animal Diseases	A committee of Commonwealth and State/Territory CVOs and CSIRO/AAHL, chaired by the Australian CVO (Cwlth), to consult in emergencies due to the introduction of an exotic disease of livestock, or serious epizootics of Australian origin.
Control area	A declared area in which defined conditions apply to the movement into, out of, and within, of specified animals or things. Conditions applying in a control area are of lesser intensity than those in a restricted area.
Dangerous contact premises	Premises containing a dangerous contact animal(s).
Decontamination	Includes all stages of cleaning and disinfection.
ELISA	Enzyme-linked immunosorbent assay–a serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen–antibody binding occurs.
Emergency animal disease	Includes exotic animal diseases and endemic diseases that warrant a national emergency response.
Epizootic	Disease affecting a large number of animals simultaneously; spreading rapidly through a large area (if epidemic).
Fomites	Inanimate objects (eg boots, clothing, equipment, vehicles, crates, packagings) that can carry the exotic agent and spread the disease through mechanical transmission.
Immunoglobulin	Antibody proteins
IgG	The main form of immunoglobulin produced in response to an antigen. It is mainly found in body fluids.
IgM	High molecular weight immunoglobulin; IgM antibodies are the first to be synthesised and released in response to a primary antigenic stimulation.
Incubation period	The period which elapses between the introduction of the pathogen into the animal and the occurrence of the first clinical signs of the disease.
Index property	The property on which the first or original case (index case) in a disease outbreak is identified to have occurred.
Infected premises	A premises on which an infected animal has been confirmed.
Local disease control centre	An emergency operations centre responsible for the command and control of field operations in a defined area.
Haemagglutination	Agglutination of red blood cells by a specific antibody or other substance.

Movement controls	Restrictions placed on movement of animals, people and things to prevent spread of disease.
Premises	A defined area or structure, which may include part or all of a farm, enterprise or other private or public land, building or property.
Quarantine	Legal restrictions imposed on a place, animal, vehicle or other things limiting movement.
Restricted area	A declared area in which defined rigorous conditions apply to the movement into, out of, and within, of specified animals, persons or things.
Risk enterprise	A livestock or livestock-related enterprise with a high potential for disease spread, eg an abattoir, milk factory, artificial breeding centre or livestock market.
Sentinel animals	Animals used for the express purpose of detecting the presence of lyssavirus.
Stamping out	Eradication procedures based on quarantine and slaughter of all infected animals and animals exposed to infection.
State/Territory disease control headquarters	The emergency operations centre that directs the disease control operations to be undertaken in the State/Territory.
Surveillance	A systematic program of inspection and examination of animals, insects or things to determine the presence of lyssavirus.
Susceptible species	Animals that can be infected with the disease (for lyssavirus this includes all mammals).
Suspect animal	An animal that may have been exposed to an exotic disease such that its quarantine and intensive surveillance is warranted; OR an animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.
Suspect premises	Premises containing suspect animals that will be subject to surveillance.
Tracing	The process of locating animals, persons or things that may be implicated in the spread of disease, so that appropriate action be taken.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A *biological* vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A *mechanical* vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.
Vector competence	The ability of a blood-sucking insect to become infected with an arbovirus after ingestion of an infective blood meal, and to transmit the virus subsequently when feeding on a vertebrate host.
Viraemia	The presence of viruses in the blood.
Zoning	Dividing a country into defined infected and disease-free zones. A high level of movement control between zones will apply.
Zoonosis	Disease transmissible from animals to people.

Abbreviations

AAHL	CSIRO Australian Animal Health Laboratory, Geelong
AFFA	Department of **Agriculture Fisheries and Forestry – Australia**
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
CA	Control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CMO	Commonwealth medical officer
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	Chief veterinary officer
EDTA	Ethylene diamine tetra-acetic acid (anticoagulant for blood)
ELISA	Enzyme-linked immunosorbent assay
Ig	Immunoglobulin
IP	Infected premises
OIE	World Organisation for Animal Health [Office International des Epizooties]
RA	Restricted area
RFFIT	Rapid fluorescent focus inhibition test
SP	Suspect premises

REFERENCES AND FURTHER READING

Video/training resources

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

OIE publications

OIE Manual (1996). *Manual of Standards for Diagnostic Tests and Vaccines* (3rd edition), OIE, Paris, France.

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