Australian bat lyssavirus

Fact sheet

August 2023

Key points

- Australian bats are the natural reservoirs for Australian bat lyssavirus (ABLV).
- Both flying-foxes and insectivorous bats (or 'microbats') may be infected.
- ABLV can infect humans and other mammals. It causes similar clinical signs to rabies lyssavirus in infected people, bats and other animals.
- Infection causes acute, fatal, neurological disease in humans, if preventative treatment is not implemented. There is no treatment once disease has developed.
- All bats, regardless of their clinical state, should be managed as if potentially infected with ABLV.
- ABLV is a nationally notifiable disease in animals and humans in Australia; you must notify health authorities if you suspect an animal or a human has ABLV (see *Surveillance and management*).

Aetiology

Australian bat lyssavirus (ABLV) belongs to the same family as (but is distinct from) rabies lyssavirus. The causative agent of ABLV is a virus: family *Rhabdoviridae*, genus *Lyssavirus* genotype 7 [1]. Rabies lyssavirus affects carnivores and, in North America, bats. Like ABLV, some other lyssavirus genotypes solely or mainly affect bats (e.g. Lagos, Duvenhage, West Caucasian and Bokeloh lyssaviruses, and European bat lyssavirus-1 and -2). There are two known sub-lineages of ABLV, the yellow-bellied sheathtail bat variant and the pteropid variant [2-5].

One Health implications

Wildlife and the environment: ABLV causes fatal disease in bats but is unlikely to have a direct impact on population numbers.

Domestic animals: animals infected with ABLV develop fatal neurological disease, as seen in two horses in Qld. All mammal species are probably susceptible, but risk may vary with species.

Humans: ABLV infection causes an acute, fatal, neurological disease in humans, if preventative treatment is not implemented. Three humans have died from ABLV following the bite or scratch of a bat and there is no effective treatment following the onset of clinical disease.

Deaths from ABLV infection may only be prevented by **proactively taking preventive action**. People should not handle bats unless they have been effectively vaccinated and trained, and are wearing appropriate personal protection equipment. First aid should be commenced immediately if there is any suspicion of exposure to ABLV, and health care providers should be contacted urgently (see Prevention and control).

For more information consult "Rabies, Australian bat lyssavirus and other lyssaviruses – Information for consumers" (Department of Health) www.health.gov.au/diseases/australian-bat-lyssavirus-infection.

For medical professionals: Rabies and ABLV Series of National Guidelines (SoNG) www.health.gov.au/resources/publications/rabies-and-other-lyssavirus-cdna-national-guidelines-for-public-health-units [6].

The Australian Immunisation Handbook https://immunisationhandbook.health.gov.au/contents/vaccine-preventable-diseases/rabies-and-other-lyssaviruses.

Natural hosts

ABLV infections have been detected in all four of the mainland species of **flying-fox** in Australia:

- *Pteropus alecto* (black flying-fox)
- *P. scapulatus* (little red flying-fox)
- *P. poliocephalus* (grey-headed flying-fox)
- *P. conspicillatus* (spectacled flying-fox).

ABLV infection has also been confirmed in one species of insectivorous **microbat**, the yellow-bellied sheathtail bat (*Saccolaimus flaviventris*). Additionally, antibodies have been identified in seven genera within five of the seven families of Australian microbats: *Chaerephon* and *Austronomus* (family *Molossidae*), *Chalinolobus, Vespadelus, Falsistrellus* and *Nyctophilus* (family *Vespertilionidae*), *Hipposideros* (family *Hipposideridae*), *Macroderma* (family *Megadermatidae*) and *Saccolaimus* (family *Emballonuridae*) [7, 8].

It should be assumed that all bat species are potential hosts of ABLV. All bats, regardless of their clinical state, should be managed as if potentially infected with ABLV.

There have been three cases of ABLV disease in **humans** following a bite or scratch from a bat, all of which have been fatal [9-12]. Two **horses** with neurological disease, sharing a paddock in south-east Qld were found to be infected with ABLV in 2013 [13]. This was the first time ABLV had been detected in an animal other than a bat or human. Antibody-positive, asymptomatic dogs have occasionally been detected in NSW and Qld [14]. In 2013 a dog in NSW that had caught and eaten a flying-fox tested antibody positive for ABLV, however after the dog was euthanased, it tested negative for ABLV by lyssavirus FAT, and both ABLV and rabies virus PCRs [15]. It is probable that **all mammal species are susceptible** to infection because other lyssaviruses naturally infect numerous mammal species e.g. European bat lyssavirus 1 [16, 17].

In an experimental study, three cats and five dogs inoculated with ABLV developed antibodies; all individuals survived although some showed mild transient behavioural changes. There was no evidence of virus excretion and no ABLV was detected at necropsy [18].

World distribution

ABLV has only been reported in Australia. Antibodies detected in bats in the Philippines indicate the presence of a naturally occurring lyssavirus related to ABLV. It is probable that variants of ABLV, or a similar virus, are present in bats in south-east Asia [19, 20].

Occurrences in Australia

ABLV was first detected in 1996 in a black flying-fox. While there are limited historical samples, there is one retrospectively diagnosed case, a black flying-fox from January 1995 [9-11, 21]. ABLV infected bats have been reported from most states and territories of Australia (Table 1), and serological evidence suggests a wide geographical distribution in bats in Australia [7]. For up-to-date information see *ABLV Bat Stats*.

Table 1: ABLV infection in Australian bats as confirmed by FAT, PCR, IHC and/ or virus isolation^, to 2022

Year	NSW	NT	Qld	Vic	WA	SA	Total
1995	0	0	1	0	0	0	**1**
1996	1	0	9	1	0	0	**11**
1997	7	1	27[+]	0	0	0	**35**
1998	1	0	26[+]	0	0	0	**27**
1999	0	0	6	0	0	0	**6**
2000	1	0	14	0	0	0	**15**
2001	0	0	9	1	4	0	**14**
2002	4	0	10	2	1	0	**17**
2003	5	0	3	2	0	0	**10**
2004	5	0	6	1	0	0	**12**
2005	6	0	5	0	0	0	**11**
2006	2	0	4	0	0	0	**6**
2007	6	0	2	0	0	0	**8**
2008	0	0	0	0	0	0	**0**
2009	2	0	8	0	0	0	**10**
2010	0	0	8	0	1	0	**9**
2011	0	0	4	2	0	0	**6**
2012	1	0	3	0	0	1	**5**
2013	3	0	11	0	0	0	**14**
2014	5	1	14	1	11	0	**32**
2015	10	1	11	0	0	0	**22**
2016	5	1	8	1	0	0	**15**
2017	4	0	19	3	2	0	**28**
2018	5	0	5	1	0	0	**11**
2019	6	0	1	0	0	0	**7**
2020	5	0	9	4	0	0	**18**
2021	10	1	17	5	0	2	**35**
2022	1	1	8	1	0	1	**12**
Total	**95**	**6**	**248**	**25**	**19**	**4**	**397**

Source: '*ABLV Bat Stats Australian bat lyssavirus report*' [22].
^ ACT and Tas have not recorded any cases of ABLV infection that satisfy this case definition.
[+] Higher numbers of ABLV infected bats were associated with peak years of testing in 1997-1998.

Epidemiology

The epidemiology of ABLV is known to be similar to that of other lyssaviruses, although aspects of the population dynamics are still not fully understood. Studies suggest that the prevalence of ABLV in Australian bat populations is low [2, 7]. A study of 475 wild-caught flying-foxes found no evidence of current ABLV infection [7], and in another study there were no detections of ABLV infection in over 300 clinically normal, wild-caught flying-foxes and insectivorous bats [23]. This is consistent with a population prevalence of less than 1%. In sick, injured or orphaned bats (which are also more likely to be in contact with wildlife carers or the general public) the prevalence of ABLV is higher [2, 7]. From 2010-2022, between 5 and 32 lyssavirus-positive bats were detected annually in Australia. This represents a range of 1.0 to 9.5% of bats submitted for testing (e.g. due to human or pet contact, neurological signs or unusual behaviour, or bats found dead or euthanased for welfare reasons), noting that these figures are not representative of the wider bat population. Clusters of ABLV infection in bat populations are occasionally identified [24, 25].

ABLV is most frequently detected in adult bats, however bats of any age may be infected with ABLV. In 2015, several 3-4 week-old grey-headed flying-foxes developed neurological signs while in care and died as a result of ABLV. Large numbers of in-contact people had been potentially exposed to the virus [26]. In 2017, ABLV infection was confirmed in 11 spectacled flying-fox pups from two groups brought into care from two separate locations in Far North Qld. These pups displayed neurological signs and died over an 11-day period [25]. The National Wildlife Health Information System (eWHIS) contains numerous other reports of dead or rescued juvenile bats testing positive for ABLV.

Analysis of the national ABLV dataset for 2010-2016 found, as in previous studies, that little red flying-foxes are more likely than other species to be infected with ABLV. There were seasonal differences in infection risk in the four flying-fox species, possibly associated with reproductive cycles, with summer and autumn the highest risk. As expected, neurological signs were associated with ABLV infection, and a presentation of 'grounded' or unusual behaviour was common for ABLV infected bats [24].

ABLV is transmitted when the saliva of an infected animal is introduced via a bite or scratch, or by contamination of mucous membranes or broken skin. **Immediate action is required if a person has been potentially exposed to ABLV (e.g. via a bat bite, scratch or other significant contact) [see Prevention and control]**. Other modes of transmission such as environmental contamination (e.g. aerosols) are of minor significance for rabies transmission and are expected to have a similarly minor role in the transmission of ABLV. Contact with faeces, urine or blood from a lyssavirus-infected animal is not considered to pose a risk of transmission of ABLV [14].

Clinical signs

Infection in bats and humans appears to follow a similar course to rabies in other mammals, with a relatively long, variable incubation period. A 10-to-29 day incubation has been reported in experimentally-infected bats or in captive colonies exposed to infected bats [2, 27-29]. This is followed by an acute, progressive and fatal clinical disease manifested as abnormal behaviour and paralysis.

Clinical signs are not always present in infected individuals (e.g. during the incubation period) and apparently healthy bats with normal behaviours may be infected with ABLV.

The following clinical signs in bats should raise a high index of suspicion of ABLV infection (especially if occurring with species and presentation risk factors as described in *Epidemiology*):

- excitation/ agitation
- aggression including unprovoked attacks
- unusual vocalisation or abnormal function of mouth
- paralysis or paresis; inability to fly
- seizures/ tremors.

Bats with apparent respiratory difficulties should also be treated with increased suspicion for ABLV infection.

The two horses that were infected with ABLV both presented with clinical signs consistent with lyssavirus infection including pyrexia, depression and hind limb ataxia progressing to recumbency [13].

Diagnosis

The case definition for lyssavirus infection in all species of animals as provided in the AUSVETPLAN Disease Strategy: Lyssaviruses (Version 5.0) [14] is "*an animal that demonstrates the presence of lyssavirus genome or antigen in tissues or secretions*".

Diagnosis of ABLV in animals on the basis of clinical signs and gross necropsy alone should not be considered definitive. Definitive diagnosis for ABLV is by laboratory detection of viral antigen or RNA. Brain is the preferred tissues for detection of ABLV infection (other nervous tissue (including salivary glands) can be used if brain/the head is not available, but brain is preferred). The fluorescent antibody test (FAT) provides rapid and reliable diagnosis of any lyssavirus infection in brain or other neurological tissue but is not specific for ABLV. Further testing by PCR is required to definitively identify the lyssavirus as ABLV and to differentiate the variant.

There is no reliable ante-mortem diagnostic test for ABLV in animals. While ante-mortem confirmatory diagnosis of clinical cases is possible in humans and horses (e.g. virus or RNA detection in saliva or cerebrospinal fluid), virus is not consistently present in samples other than brain, and testing in a live animal is not considered reliable for diagnosis of ABLV infection [14].

Serology is a valuable tool for ABLV surveillance at a population level but does not confer a clinical diagnosis, only evidence of exposure to lyssavirus or another cross-reacting antigen. Antibody levels during the incubation period may be below detectable thresholds.

Laboratory diagnostic specimens and procedures

Submitters should contact the state/territory laboratory for advice on sample collection and submission. In general, specimens should be chilled (preferably not frozen) and forwarded on ice to the relevant state or territory veterinary laboratory. Carcasses should be submitted whole, regardless of whether the head or parts of the skull are missing. Unless the operator is vaccinated and experienced, the head or brain should not be removed before submission due to the potential for self-inoculation. If the brain is to be removed, the laboratory should be contacted for advice on sample collection and storage. Other tissues (salivary gland, spinal cord, and peripheral nerves and ganglia) can be tested but are less reliable for detection of ABLV than brain.

It is essential that all clinical details are recorded, including a reliable taxonomic identification of the bat. If the species cannot be confirmed at the time of necropsy, photographs, along with the skull and carcass, should be retained for later identification by an experienced taxonomist.

The state/territory laboratory may forward specimens for testing or confirmation to the Australian Centre for Disease Preparedness.

Definitive laboratory tests (detecting virus) include:

- fluorescent antibody test (FAT) on fresh brain or other nervous tissues (including salivary glands). This is not specific for ABLV, but detects a range of lyssaviruses.
- polymerase Chain Reaction (PCR) assay on fresh brain or other nervous tissues. These are molecular tests that detect the presence of the viral nucleic acid. There are several types of PCR tests designed to detect ABLV and other lyssaviruses. Immunohistochemistry on fixed brain or nervous tissue can be used to identify the lyssavirus antigen.

Supportive laboratory tests (detecting post-exposure or prior infection - primarily useful for population dynamics and to further investigate the natural history of infection) include serum virus neutralisation tests for rabies and ABLV [14].

Clinical pathology

No specific clinical pathological changes are recognized in ABLV infections.

Pathology

There may be no gross changes in bats that die from ABLV however poor body condition, a full bladder or impaction with food or other material in the mouth may be detected in bats with ABLV infection. The presence of other gross lesions may be as a result of ABLV-induced behavioural changes (e.g. trauma).

Histologically, there may be a non-suppurative meningoencephalitis, with perivascular lymphocytic cuffs, gliosis, meningitis, neuronal degeneration, intracytoplasmic vacuolation and neuronal intracytoplasmic eosinophilic inclusions (Negri bodies), and sialoadenitis, but the extent and severity of these lesions are variable and may be absent [2, 29, 30].

Differential diagnoses

In one study, neurological syndromes in flying-foxes were attributed to: ABLV (32%); spinal and head injuries (29%); and neuro-angiostrongyliasis (infection of the brain with the nematode parasite *Angiostrongylus cantonensis*; 18%) [2]. Rabies (exotic to Australia), trauma (e.g. broken wing bones, head and spinal injuries), toxoplasmosis, lead poisoning and other toxicities, and other causes of neurological disease should also be considered [31, 32].

Treatment

There is no specific treatment for ABLV once the disease develops and it is almost invariably fatal. Immediate action following potential exposure to an infected bat is of the utmost importance (see Prevention and control).

Prevention and control

Only rabies-vaccinated people who are experienced in handling bats and wearing appropriate personal protective equipment (PPE) should handle, rescue or examine a bat (see https://wildlifehealthaustralia.com.au/Portals/0/ResourceCentre/BatHealth/PPE_Info_for_Bat_Handlers.pdf)**.** Prevention of transmission should be based on avoiding potential contact with bats wherever possible, particularly those showing neurological signs. Community members should not handle bats. If a sick or injured bat requires help, contact a wildlife care organisation or your local veterinarian. If bats must be handled, every effort should be made to avoid being bitten or scratched. Contact between bats and other animals should be minimised.

Rabies vaccination provides some degree of cross-protection against ABLV in humans and animals [2]. Pre-exposure vaccination is recommended (following a risk assessment by a medical practitioner) for people whose occupation or recreation activities place them at increased risk of being bitten or scratched by bats [6]. Consult the current edition of The Australian Immunisation Handbook for further information about rabies vaccination [33].

In the event of a bat bite, scratch or other significant contact, **apply immediate first aid** and **seek URGENT medical attention.** Bite or scratch wounds should **immediately** be washed thoroughly with soap and copious water for approximately 15 minutes and a virucidal antiseptic (e.g. povidone-iodine, iodine tincture, aqueous iodine solution or ethanol) applied after washing [6]. Bat saliva in the eyes or mouth should be rinsed out immediately and thoroughly with water. Post-exposure prophylaxis may be administered to people with suspected or confirmed ABLV exposure. Contact your doctor or the local public health agency for more information and advice.

If contact between a bat and other animal has occurred, wash the wound where possible (as for human exposure) and **seek urgent veterinary advice.** Post-exposure prophylaxis (vaccination) may be available for domestic pets with suspect or confirmed exposure to an ABLV-positive bat. Contact a local veterinarian or the state/territory biosecurity agency for more information.

ABLV is endemic in wild bat species and control is not possible. In captive bat colonies (including those at wildlife rescue facilities), transmission can be minimised by avoiding contact with wild bats, keeping a closed colony, practicing all-in-all-out management and quarantine of incoming bats [14, 34]. See the *AUSVETPLAN for Lyssaviruses, Appendix 3*, for more information on management of ABLV risk in bats in captivity and care.

ABLV is a nationally notifiable disease in both animals and humans. If a bat is suspected to be infected with ABLV, the state/territory biosecurity agency should be contacted for advice about testing, or call the Emergency Animal Disease Watch Hotline on **1800 675 888**.

The Qld government Dept of Agriculture and Fisheries has a document "Australian bat lyssavirus guidelines for veterinarians" www.business.qld.gov.au/industries/service-industries-professionals/service-industries/veterinary-surgeons/bat-lyssavirus and a similar NSW government document is available www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/513547/Australian-Bat-Lyssavirus-guidelines-for-veterinarians.pdf.

Research

Key questions for investigation include:

- What is the impact of ABLV on other (non-bat) animals?
- Is there a role for non-bat animals in transmission of ABLV to humans?
- How does ABLV differ from rabies?
- What are the dynamics of ABLV in bat populations?
- Could a non-lethal test be developed for ABLV in bats?

Further research could better quantify and mitigate the risks of ABLV to humans, bats and other animals.

Surveillance and management

The *AUSVETPLAN for Lyssaviruses* should be referred to for more information [14]. ABLV is not a WOAH-listed disease and Australia maintains 'rabies-free' status because the genotype of ABLV is recognized by the WOAH as sufficiently distinct from rabies lyssavirus and the epidemiology of ABLV poses negligible risks to trade.

ABLV is a **nationally notifiable disease** in both animals and humans [35, 36] (see www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/notifiable). By law you must notify animal health authorities in your jurisdiction if you know or suspect that an animal has ABLV. Refer to advice in your jurisdiction (www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/state-notifiable) and outbreak.gov.au on how to report.

Surveillance for ABLV is mainly through submission of bats associated with human or animal contact, or showing neurological signs, for laboratory testing. Increased surveillance may be undertaken if ABLV is diagnosed in a non-bat species. WHA maintains a national dataset of ABLV testing in bats. A six-monthly summary of the data is available through the WHA publication *ABLV Bat Stats* www.wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx [22].

Links to other ABLV information resources for each state/territory may be found on the WHA website https://wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/All_States_ABLV_Resources.pdf under Resources; Disease and disease agents; Australian bat lyssavirus, and on the WHA Bat Health Focus Group page.

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information https://wildlifehealthaustralia.com.au/Our-Work/Surveillance and https://wildlifehealthaustralia.com.au/Our-Work/Surveillance/eWHIS-Wildlife-Health-Information-System.

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Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

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