

# **RABIES VIRUS AND OTHER LYSSAVIRUS (INCLUDING AUSTRALIAN BAT LYSSAVIRUS) EXPOSURES AND INFECTIONS**

## **CDNA NATIONAL GUIDELINES FOR PUBLIC HEALTH UNITS**

The Series of National Guidelines have been developed in consultation with the Communicable Disease Network Australia and endorsed by the Australian Health Protection Principal Committee (AHPPC). Their purpose is to provide nationally consistent advice and guidance to public health units (PHUs) in responding to a notifiable disease event. These guidelines capture the knowledge of experienced professionals, built on past research efforts, and provide advice on best practice based upon the best available evidence at the time of completion.

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<b>Revision history</b>			
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3.0	6 December 2013	Rabies and ABL SoNG working group	Updated to include ABLV in horses

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## **CDNA NATIONAL GUIDELINES FOR PUBLIC HEALTH UNITS**

### **1. Summary**

#### **Public health priority**

Urgent.

#### **Case management**

No known effective treatment. Isolate case with standard and contact precautions for the duration of illness. Determine the source of infection.

#### **Contact management**

Urgently assess the need for post-exposure prophylaxis in people exposed to mammalian animals or confirmed human cases. Use of human rabies immunoglobulin (HRIG) and rabies vaccine is dependent on the type of exposure and prior vaccination.

### **2. The disease**

#### **Infectious agents**

Rabies virus, Australian bat lyssavirus (ABLV), and other lyssaviruses such as European bat lyssavirus (EBLV) 1 and EBLV 2, are members of the *Rhabdoviridae* family, genus *Lyssavirus*. Twelve closely related but distinct lyssavirus species have been formally recognised. <sup>1</sup> Rabies virus and other lyssaviruses cause the disease rabies.

#### **Reservoir**

All mammals are susceptible to infection with rabies virus and are therefore possible reservoirs. Dogs are the principal reservoir of rabies virus in developing countries and are responsible for 99% of human infections. <sup>2</sup> Other reservoirs and important vectors of rabies virus include wild and domestic *Canidae*, including dogs, foxes, coyotes, wolves and jackals; and bats, cats, monkeys, skunks, raccoons, and mongooses. Other mammals may rarely be infected. Australia is currently free of rabies in terrestrial (land dwelling) mammals. However, evidence of ABLV infection has been documented in several species of flying foxes (also known as fruit bats) and insectivorous microbats. It is assumed that all Australian bat species have the potential to carry and transmit ABLV. ABLV has not been isolated from bats outside Australia. However, several lyssavirus species have been found in bats in other countries considered free of terrestrial rabies. It is assumed that bats anywhere in the world have the potential to carry and transmit lyssaviruses.

#### **Mode of transmission**

Rabies virus is transmitted by the virus-laden saliva of an infected animal introduced via a bite or scratch, or by contamination of mucous membranes or broken skin. Person-to-person transmission via saliva is extremely rare and has not been well documented. There have been rare reports of rabies virus transmission by transplantation of infected tissues/organs <sup>3</sup> and via inhalation of virus-laden aerosol in laboratory settings. <sup>5-6</sup> Aerosol transmission in humans has not been proven in the natural environment but based on animal experiments it remains theoretically possible. <sup>7-8</sup>

The only three known human cases of ABLV infection occurred in people who had been bitten or scratched by bats. It is assumed that the mode of transmission for ABLV and other lyssaviruses is similar to that of rabies virus.

### **Incubation period**

The incubation period for rabies virus infection is usually 3-8 weeks, rarely as short as a few days or as long as several years.<sup>9</sup> The length of the incubation period depends on many factors including wound severity, wound location in relation to nerve supply, proximity to the brain, size of inoculum of virus and the degree of protection provided by clothing and other host factors.<sup>9</sup> The incubation period for ABLV and other lyssavirus infections is less certain but is assumed to be similar to rabies virus; the first two documented cases of ABLV infection had likely incubation periods of approximately 4 weeks and over 2 years, respectively.<sup>10</sup> The likely incubation for the third case has not been confirmed.

### **Infectious period**

The infectious period for rabies virus infection has been described reliably only in dogs, cats and ferrets, in which communicability usually commences 3-7 days before onset of clinical signs and persists throughout the course of the illness.<sup>9</sup> The period of communicability of ABLV and other lyssaviruses is not known.

### **Clinical presentation and outcome**

As the clinical disease caused by classical rabies virus and other lyssaviruses appears to be indistinguishable, the term 'rabies' refers to disease caused by any of the known lyssaviruses. Rabies is an almost invariably fatal, acute viral encephalomyelitis. Initial symptoms include fever and sensory changes (pain or paraesthesia) at the site of a preceding animal bite. Other reported prodromal symptoms include a sense of apprehension, headache and malaise. There are 2 clinical forms of rabies. Encephalitic or furious rabies presents in about two-thirds of cases, and is characterised by hyperactivity and aerophobia and/or hydrophobia followed by delirium with occasional convulsions. The second form, paralytic or dumb rabies, presents in about one-third of cases, with paralysis of limbs and respiratory muscles with sparing of consciousness.<sup>11</sup> Phobic spasms may be absent in the paralytic form. Death from cardiac or respiratory failure occurs within a few days for furious rabies and within 1-2 weeks for the paralytic form of the disease.<sup>29</sup>

### **People at increased risk of disease**

The risk of infection after the bite of a rabid animal can range from less than 1% to over 80%, presumably related to the size of inoculum, severity of bite, nerve density in the area of the bite, proximity of the bite to the central nervous system, vaccination status and immunocompetence.<sup>12</sup> People at increased risk of rabies are those whose occupational, volunteering, or recreational activities put them at increased risk of exposure, i.e. being bitten or scratched by animals in rabies-enzootic countries or by bats anywhere in the world. In Australia, therefore, risk is greatest in those who holiday or work in countries in which rabies is enzootic, and in those most likely to come into contact with bat species, including wildlife carers, wildlife officers, veterinarians and those who live in areas where bats are common.

### **Disease occurrence and public health significance**

Australia is free from terrestrial rabies. Only two imported human cases have been reported in Australia in travellers returned from enzootic areas. Rabies virus is enzootic in Asia (including Southeast Asia where large numbers of Australians travel), Africa, North and South America and parts of Europe. Worldwide, it is estimated that rabies virus is

responsible for more than 50,000 deaths per year, almost all in rural areas of Asia and Africa, with the highest incidence in children under 15 years.<sup>13</sup> Rabies is estimated to have at least as much public health impact in tropical countries as dengue fever (when comparing disability-adjusted life years) and results in an estimated annual global financial burden of over US\$ 1 billion.<sup>13-14</sup> Most human deaths follow dog bites for which adequate post-exposure prophylaxis was not or could not be provided. Post-exposure prophylaxis initiated at an early stage using rabies vaccine in combination with rabies immunoglobulin may be 100% effective in preventing death. In Australia, rabies is subject to quarantine controls under Commonwealth biosecurity legislation - currently the Quarantine Act 1908. The primary concern is the prevention of the introduction of rabies virus to local dog and wildlife populations.

ABLV is unique to Australia and was first identified in 1996 in an encephalitic black flying fox. Three human cases have subsequently been reported, in 1996, 1998 and 2013 with all three cases developing fatal encephalitis after being bitten or scratched by bats.<sup>1516-1718</sup> To date, virological and/or serological evidence of ABLV infection has been found in all four species of flying foxes (megachiropterans) found in Australia, and at least seven genera of Australian insectivorous bats.<sup>19</sup> Any Australian bat should be considered a potential carrier of the virus. The risk of human exposure to ABLV is related to the extent of human contact with Australian bats. In 2013 two horses from the same Queensland property were confirmed to be infected with ABLV. Both horses displayed neurological signs and were euthanased.<sup>20</sup>

Four human deaths have been documented following bat exposures in Europe (in Ukraine, the Russian Federation, Finland and Scotland). All presented with clinical features of rabies. The causative viruses were identified as EBLV 1a, EBLV 2a, EBLV 2b, and one untyped lyssavirus.<sup>21 22</sup> Spillover infections with EBLV have been reported in 5 sheep, 2 cats and a stone marten in Europe<sup>23-25</sup>.

### **3. Routine prevention activities**

#### **Pre-exposure vaccination**

Pre-exposure vaccination with rabies vaccine is recommended for people whose occupation (including volunteer work) or recreational activities place them at increased risk of being bitten or scratched by bats, and, following a risk assessment, those who work in or travel to rabies-enzootic countries. (WHO maintain maps of rabies-enzootic areas: see [www.who.int/rabies/en/](http://www.who.int/rabies/en/); The UK Health Protection Agency (HPA) maintains a list of terrestrial rabies risk by country: see [www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb\\_C/1259152458758](http://www.hpa.org.uk/webw/HPAweb&HPAwebStandard/HPAweb_C/1259152458758)).

Current recommendations for pre-exposure vaccination include: bat handlers, veterinarians, wildlife officers, and others who come into direct contact with bats; laboratory personnel working with live lyssaviruses; expatriates and travellers (following a risk assessment) who will be spending time in rabies-enzootic areas; and people working with mammals in rabies-enzootic areas.<sup>26</sup>

Pre-exposure vaccination with rabies vaccine consists of 3 doses by intramuscular (IM)\* injection; with the second dose 7 days after the first and the third dose 21-28 days after the first dose. Booster doses are not required for anyone who has received 3 or more previous IM doses of rabies vaccine, if their only exposure risk is travelling to or living in a rabies enzootic area.<sup>13</sup> Booster doses may be required if there is an ongoing occupational

(including volunteer work) exposure risk, on the basis that there may be increased likelihood of an inapparent exposure occurring. An algorithm outlining the approach to booster doses is provided at Appendix 1. Consult the current edition of The Australian Immunisation Handbook if further information on vaccine administration and booster doses are required.<sup>26</sup> See

<http://www.immunise.health.gov.au/internet/immunise/publishing.nsf/Content/Handbook10-home>

*\*As described in the Australian Immunisation Handbook, there are two rabies vaccine preparations available in Australia, one a human diploid cell vaccine (HDCV) and the other a purified chick embryo cell vaccine (PCECV). PCECV must be given by the IM route, but HDCV may be given by either the IM or subcutaneous (SC) route. For simplicity, all descriptions of administration of rabies vaccine in these Guidelines refer to the IM route.*

It is strongly recommended that the IM route be used for pre-exposure vaccination in Australia. Antibody titres at 14 days are lower and wane more rapidly after intradermal (ID) administration of rabies vaccine, and there may be a slower initial immune response following exposure to rabies virus.<sup>27 28</sup> As rabies vaccines are not licensed for intradermal use in Australia, any use of this method is the practitioner's own responsibility. If ID rabies pre-exposure vaccination is considered (using a dose of 0.1 mL on days 0, 7 and 28) it is essential that:

- it is given by those with not only expertise in, but also regular practice of, the ID technique
- it is not administered to anyone who is immunocompromised
- it is not administered to those taking either chloroquine or other antimalarials structurally related to chloroquine (e.g. mefloquine) at either the time of, or within a month following, vaccination
- any remaining vaccine is discarded at the end of the session during which the vial is opened (i.e. within 8 hours)
- the rabies virus neutralising antibody (VNA<sub>b</sub>) level is checked 14 to 21 days following completion of the pre-exposure course of ID vaccine.
- It is only used for pre-exposure vaccination for classical rabies exposures (there are no data on the protection provided by ID rabies vaccination for the prevention of infection with other lyssaviruses including ABLV).<sup>29</sup>

## **Handling bats**

Only appropriately vaccinated and trained people should handle bats. Community members should not handle bats and should contact the nearest registered vaccinated wildlife carer (through a wildlife service or carer group), wildlife officer or veterinarian for assistance if a bat requires rescuing. If bats must be handled, safety precautions, such as wearing protective gloves and clothing, should be observed. Every effort should be made to avoid being bitten or scratched.

## **Travel advice**

Travellers should be advised to avoid close contact with bats anywhere in the world. Travellers to rabies-zoonotic regions should also be advised to avoid close contact with wild or domestic terrestrial mammals (especially dogs, cats and monkeys). Travellers should also be advised what to do should they be bitten or scratched by an animal while abroad. This advice should include stressing the importance of obtaining as much written detail as possible on any post-exposure management provided overseas. Parents should ensure that their children are careful around animals as children are at optimal height for high-risk bites to the face and head. Rabies pre-exposure vaccination (or if appropriate, booster doses)

should be advised pre-travel where indicated by a risk assessment, which should include ease of access to post-exposure prophylaxis (PEP) and likelihood of interaction with animals based on type of accommodation and planned activities.

## **Management of potential human exposure to rabies or other lyssaviruses, including ABLV (see algorithms in Appendices 2-3)**

### ***Definition of potential exposure***

Any bite or scratch from, or mucous membrane or broken skin contact with the saliva or neural tissues of:

- a bat in Australia or elsewhere in the world
- a wild or domestic terrestrial mammal in a rabies-enzootic country – this includes Bali, Indonesia from August 2008 onwards
- a wild or domestic terrestrial mammal in Australia, where there is laboratory confirmation of infection with any lyssavirus – see also Domestic animal exposed to a bat in Australia.

If there are concerns about other potential exposures, expert advice should be sought.

### ***Principles of post-exposure management***

Post-exposure management is recommended for any person with a potential exposure. Post-exposure management comprises wound care and administration of a combination of rabies vaccine and human rabies immunoglobulin (HRIG), depending on exposure category and prior vaccination or antibody status. Post-exposure management should generally commence as soon as possible following potential exposure. If a traveller presents more than 10 days after being bitten or scratched by a domestic dog, cat or ferret in a rabies-enzootic country, and it can be reliably ascertained that the animal remains healthy, then post-exposure management is not required. Note that this recommendation does not apply to exposures to other animals, including bats, that may be documented to be alive beyond 10 days after the exposure.

Bats involved in a potential ABLV exposure in Australia should be tested where possible, without placing others at risk of exposure. In such situations PEP can be delayed for 48 hours post-exposure to enable a result from the bat to be received. If results are not likely to be available within 48 hours of exposure then PEP should be commenced. If the bat tests negative, PEP is not required, and may be discontinued if already commenced.

### ***Wound care***

Immediate cleansing of the wound is an important measure for minimising transmission risk.<sup>30</sup> Animal studies have shown that immediate and thorough cleansing of the wound reduces the risk of infection.<sup>31 32</sup> All wounds should be washed thoroughly for at least 5 minutes with soap and copious water, as soon as possible after the exposure. A virucidal antiseptic solution such as povidone-iodine or alcohol should be applied.<sup>13</sup> The wound should not be sutured unless unavoidable, and then should only occur after HRIG administration, where indicated. Consideration should also be given to the possibility of tetanus and other wound infections, and appropriate measures taken.

***Lyssavirus exposure categories, to be used in conjunction with algorithms in Appendices 2-3)***

Type of exposure	Description
Category I	Touching or feeding animals, licks on intact skin, as well as exposure to blood, urine or faeces or to an animal that has been dead for more than 4 hours
Category II	Nibbling of uncovered skin, minor scratches or abrasions without bleeding
Category III	Single or multiple transdermal bites or scratches, contamination of mucous membrane with saliva from licks, licks on broken skin

Source: Modified from WHO 2010<sup>13</sup>

***Post-exposure prophylaxis for people not previously vaccinated***

Potential rabies virus and other lyssavirus (including ABLV) exposures

Immunocompetent people should receive 4 doses of rabies vaccine by IM injection on days 0, 3, 7 and 14. Where applicable, a single dose of HRIG should also be given as outlined in Appendices 2-3.

Immunosuppression

Immunocompromised people (whether through disease or treatment) should receive five doses of vaccine IM on days 0, 3, 7, 14 and 28, for both rabies and other lyssavirus (including ABLV) potential exposures. Where applicable, a single dose of HRIG should also be given, as outlined in Appendices 2-3. A person who is immune-suppressed should have rabies virus neutralising antibody (VNAb) titre checked 2 to 3 weeks after completion of the vaccine regimen. If the titre is <0.5 IU/ml a further dose of vaccine should be given and serology re-checked 2 to 3 weeks later. Where the titre remains suboptimal (<0.5 IU/mL) an infectious diseases expert should be consulted about the need for further doses.

***Post-exposure prophylaxis for people previously vaccinated***

People who have documented evidence of a completed IM course of pre-exposure prophylaxis or PEP using an appropriate cell culture based rabies vaccine at any time in the past, or who have documented rabies VNAb titres  $\geq 0.5$  IU/ml<sup>13</sup> (e.g. at any time subsequent to a course of ID pre-exposure vaccination), should receive 2 doses of vaccine IM on days 0 and 3. HRIG is not required. If vaccination status is uncertain, management should occur as for people not previously vaccinated.

Immunosuppression

Previously vaccinated people who are immunocompromised (whether through disease or treatment) should have rabies virus neutralising antibody (VNAb) titre checked 2 to 3 weeks after the second dose of vaccine. If the titre is <0.5 IU/ml an infectious diseases expert should be consulted about the total number of doses required for PEP.

***Rabies vaccine use***

For adults and children one year of age or older, the rabies vaccine should be administered into the deltoid area, as administration in other sites may result in reduced neutralising antibody titres. In infants under 12 months of age, administration into the anterolateral aspect of the thigh is recommended.

### ***HRIG use***

HRIG, where indicated, should be infiltrated at a dose of 20 IU/kg in and around all wounds. It is imperative that as much HRIG as possible is given in and around the wound/s. It may be diluted if there are multiple wounds but as much as possible should go into and around the wounds. The balance of any HRIG dose that cannot safely be infiltrated in and around the wound, or the whole HRIG dose in situations such as mucous membrane exposures (where there is no wound), should be given IM (not into fat) at a site distant (e.g. alternative deltoid, lateral thigh, or gluteal muscle, depending on volume) to that where rabies vaccine is given.

HRIG is given to provide localised anti-rabies antibody protection while the person mounts an immune response to the rabies vaccine. HRIG should be administered with the first dose of rabies vaccine (day 0). If this is not possible, HRIG can be given up to day 7 following the first dose of vaccine, but it is not recommended from day 8 onwards as it may suppress the immune response to the vaccine.

### Periods of HRIG shortage

Recurrent shortages of HRIG have occurred in Australia. From time to time, HRIG prioritisation measures may be implemented, at the recommendation of the Communicable Diseases Network Australia. Similarly, special arrangements may be made for use of unregistered HRIG or equine RIG products. In such circumstances, CDNA and jurisdictional disease control units will provide advice on variations to recommendations provided in these guidelines.

### ***Management of PEP in people who have begun prophylaxis overseas***

The principle of management of PEP in people who have begun prophylaxis overseas is to continue the course if treatment was commenced overseas with an appropriate cell culture derived vaccine. International advisory groups state that cell culture based vaccines can be used interchangeably to complete a treatment course.<sup>29</sup> HRIG should be given if indicated, as outlined in Appendices 2-3, if RIG (whether equine or human) was not given and the person presents up to day 7 following the first vaccine dose. If the person presents from day 8 onwards then HRIG should not be administered.

A number of WHO endorsed rabies PEP schedules are used overseas. These include:

- Zagreb schedule (2 doses on day 0, single doses on days 7 and 21)
- Essen schedule (doses given on days 0, 3, 7, 14 and either 28 or 30)
- Modified Essen schedule (doses given on days 0, 3, 7 and 14)

The following table provides recommended courses of action for continuation of PEP in Australia after it has been commenced overseas, for the scenarios most commonly encountered. Other situations should be dealt with on a case by case basis, informed by the following considerations:

- HRIG should not be administered if Day 8 or later following the first documented dose of rabies vaccine, even if recommencing an interrupted vaccine course, on the basis that HRIG may suppress the immune response to rabies vaccine
- Where there is good documentation that one or more doses of an appropriate cell culture based vaccine + RIG (equine or human) have been given, the schedule can generally be continued, with appropriate realignment

In situations which are not straightforward, seek expert advice on an appropriate schedule, including consideration as to whether testing of rabies VNAb titres is indicated

<b>Treatment (vaccine +/- RIG) administered overseas</b>	<b>Rabies vaccine schedule in Australia</b>	<b>Use of HRIG in Australia (Category III terrestrial animal exposures and Category II and III bat exposures only*)</b>
Unsure/unknown/poor documentation	Recommence course, starting from day 0.	Administer HRIG if up to day 7 following the first dose of rabies vaccine. Do not administer if day 8 or later.
Well documented, RIG (equine or human) given, plus vaccine given either IM or ID	Align with nearest due dose and resume schedule, adjusting for delay and administering vaccine IM (e.g. if a person had only day 0 vaccine dose + RIG overseas, and presents 6 days later, give day 3 dose immediately, day 7 dose 4 days later and day 14 dose 7 days after that).	No HRIG needed
2 doses of rabies vaccine given IM on day 0, <i>irrespective of whether</i> RIG (equine or human) administered at same time as the 1st doses.	Give further 2 doses, the first dose on day 7 and the 2nd dose on day 14. If patient presents after day 7, consider that day as day 7.	Administer HRIG if no RIG already given and if up to day 7 following the first doses of rabies vaccine. Do not administer if day 8 or later.
Immune impaired, with vaccines administered ID.	Irrespective of number of doses administer a 5-dose schedule IM and check antibody titre (see 'Immunosuppression' p 7).	Administer HRIG if no RIG already given and if up to day 7 following the first ID dose of rabies vaccine administered overseas. Do not administer if day 8 or later.
Nerve tissue vaccine (NTV)	Recommence course, starting from day 0.	Administer HRIG if no RIG already given, and if up to day 7 following first dose of NTV given overseas.

IM = intramuscular; ID = intradermal

\* See Table 'Lyssavirus exposure categories' above and Appendices 2-3 below.

## 4. Surveillance objectives

- To rapidly identify people potentially exposed to rabies virus or other lyssaviruses (including ABLV) and to provide appropriate advice and prophylaxis
- To monitor the epidemiology of rabies virus and other lyssavirus (including ABLV) infection and potential exposures to better inform prevention strategies, including travel advice.

## 5. Data management

- Only confirmed cases of rabies virus or other lyssavirus (including ABLV) infection should be reported. Data should be entered within one working day of notification.
- Data on potential human exposures and usage of HRIG and rabies vaccine should be collected and reported. De-identified data on potential exposures and vaccine/HRIG use is entered on the national database maintained by the Commonwealth Department of Health and Ageing see: [www.outbreak.health.gov.au](http://www.outbreak.health.gov.au) (log in permission provided by Health).

## 6. Communications

Immediately report any suspected or confirmed case of rabies virus or other lyssavirus (including ABLV) infection by telephone to the state/territory Communicable Diseases Branch. Include information on the possible source/s of infection, other people thought to be at risk and any PEP recommendations. If local transmission of rabies virus is suspected the appropriate state or territory veterinary authority should be contacted urgently or phone the national Emergency Animal Disease Watch Hotline on 1800 675 888 (answered locally in each jurisdiction).

## 7. Case definition

Only confirmed cases of rabies virus or other lyssavirus (including ABLV) infection are notifiable. The current surveillance case definition can be found at: <http://www.health.gov.au/casedefinitions>.

## 8. Laboratory testing

### Testing guidelines - humans

Testing for rabies virus or other lyssaviruses is indicated for persons where rabies is being considered in the differential diagnosis of a clinically compatible illness. Routine serological tests and antigen detection tests cannot distinguish between the different lyssaviruses, but they can be identified by PCR and culture. No laboratory tests are currently available to diagnose rabies in humans before the onset of clinical disease. In the early stages of disease, saliva and CSF can be tested by virus culture and PCR. Antibody testing can also be performed on CSF. A positive serum antibody test is diagnostic of infection with a lyssavirus provided the person has never been immunised against rabies and may assist in the diagnosis of rabies in advanced clinical disease. Any negative test on a symptomatic person is not definitive, as viral shedding in body secretions is intermittent and early tests may be negative for antibody. Therefore repeat testing is often indicated. Post mortem, the standard diagnostic techniques include positive fluorescent antibody test (FAT) and PCR on

fresh brain smears, and PCR and culture from tissues. Further information is available from the Public Health Laboratory Network (PHLN) case definition website:

[www.health.gov.au/internet/main/publishing.nsf/Content/laboratory+case+definitions-1](http://www.health.gov.au/internet/main/publishing.nsf/Content/laboratory+case+definitions-1)

Refer to *The Australian Immunisation Handbook* for information on routine serological testing for immunity in people who may be occupationally exposed to rabies virus or other lyssaviruses (including ABLV) or who have impaired immunity.

### **Testing and specimen submission guidelines - animals**

Testing of animals for rabies virus or other lyssaviruses (including ABLV) is indicated in any situation where a person has been exposed to a potentially infected animal. A positive result from FAT, virus culture or PCR on fresh brain smear of the animal is diagnostic of rabies.

Where possible, PHU staff should arrange for safe handling, euthanasia where relevant and ABLV testing of bats that have been involved in potential human exposures. The process by which bats or bat specimens are to be transported to the appropriate reference laboratory should be documented in protocols within each state and territory. Before shipping specimens, submitters should contact the receiving laboratory to confirm arrangements e.g. for sampling, transport and specimen reception.

Occasionally, implicated animals may be tested in overseas countries where Australians have been exposed – PHUs should endeavour to liaise with the overseas laboratory or public health authorities in such circumstances to ascertain the result.

### **Reference laboratories**

The diagnosis of rabies due to rabies virus or ABLV can be confirmed in humans by Queensland Health Forensic and Scientific Services (QHFSS) and in animals by the Australian Animal Health Laboratory (AAHL). QHFSS and AAHL may also be able to test for other lyssaviruses. QHFSS and AAHL offer both nucleic acid testing and serology. A range of other animal and human health laboratories can perform serology and a small number can perform PCR for ABLV. Reference laboratories can provide advice on interpretation of test results.

Queensland Health  
Forensic and Scientific Services  
39 Kessels Road  
Coopers Plains  
QLD 4108  
Ph 07 32749111  
Fax 07 32749119

Australian Animal Health Laboratory  
5 Portarlington Rd  
East Geelong  
VIC 3219  
Ph 03 52275000  
Fax 03 52275555

## 9. Case management

### Response times

On the same day of notification of a confirmed case of human disease begin follow up investigation and notify the state/territory Communicable Diseases Branch.

### Response procedure

#### *Case investigation*

PHU staff conducting the investigation should ensure that action has been taken to:

- confirm the onset date and symptoms of rabies
- confirm results of laboratory tests
- seek the doctor's permission to contact the case (where possible) or relevant care-giver
- interview case (if possible) or carer and determine source of infection - see Exposure Investigation.

#### *Exposure Investigation*

Determine the history of contact with bats (in Australia or overseas) or any other mammal in a rabies-enzootic country. Determine the type of animal (and for bats the species if possible), the circumstances and type of exposure, and whether other people or animals may also have been exposed.

#### *Case treatment*

There is no known effective treatment for rabies. A small number of cases of survival from rabies following intensive experimental and/or supportive treatment have been reported.<sup>33-35</sup>

#### *Education*

The rabies fact sheet should be available to carers, and provides information about the nature of infection and mode of transmission. See Appendix 5.

#### *Isolation and restriction*

Isolate patient with standard and contact precautions for the duration of the illness.

#### *Active case finding*

Active case finding should occur to determine if any other people or animals were exposed to the source animal of the case. Exposed people should be urgently assessed for post-exposure prophylaxis; exposed animals should be managed by veterinary authorities.

## 10. Control of environment

Any suspected infected animals should be isolated from other animals and humans, and veterinary investigation/management sought. For overseas exposures to domestic dogs, cats or ferrets (but not other animals) where observation of the suspected animal is possible, information on whether the dog, cat or ferret remained healthy at least 10 days after the exposure incident may be useful for assessing risk of infection and the need for completion of PEP.<sup>36</sup>

Environmental contamination by infected animals is considered negligible; this is based on knowledge of persistence of the classical rabies virus, which is fragile and does not survive for long outside the host.<sup>37</sup> It is readily inactivated by heat and direct sunlight. Bats or other

animals that have been dead for longer than 4 hours are no longer considered infectious for lyssaviruses.<sup>29</sup> Bat or other animal blood, urine, and faeces are not considered to be infectious.<sup>29</sup>

## **11. Contact management**

### **Identification of contacts**

Contact tracing is required to provide advice and post-exposure prophylaxis so as to prevent disease in contacts.

### **Contact definition**

Contacts are defined as

1. Persons who have been exposed to the saliva or neural tissue of an infectious person through mucous membrane or broken skin contact, or
2. Persons who have had mucous membrane or broken skin contact with infected or potentially infected animals. This includes any bat in Australia or overseas, any wild or domestic mammal in a rabies-enzootic country.

### **Prophylaxis**

Post-exposure prophylaxis is recommended for persons who fit the contact definition above. See *Management of potential human exposure to rabies or other lyssaviruses, including ABLV*, and follow up using *Rabies virus and other lyssavirus post-exposure prophylaxis form* (see example in Appendix 4).

### **Education**

The rabies fact sheet should be available to inform exposed contacts about the nature of infection and mode of transmission. See Appendix 5.

### **Isolation and restriction**

None required.

## **12. Special situations**

### **Domestic animal exposed to a bat in Australia**

Other than bats, two horses and three humans, no other mammals have been documented to naturally contract ABLV infection. There is no evidence that ABLV has ever been passed from a wild (non-bat) or domestic animal to a human, and no definitive evidence that any lyssavirus has ever been passed from a domestic livestock animal to a human. There is, however, a possibility that ABLV spillover to domestic animals could occur occasionally, and a theoretical (although remote) possibility that a domestic animal so infected could transmit infection to a human.

Follow-up by PHUs of incidents involving domestic animals which have suffered bites or scratches from bats is not required routinely. PHUs should, however, provide advice in accordance with this guideline if contacted by concerned owners. If the owners are concerned about the health of the domestic animal they should be referred to the relevant state or territory animal health authority. The AUSVETPLAN 2009 disease strategy for ABLV recommends testing of the bat involved in an exposure to a domestic animal. Unless the bat is proven to be negative, veterinarians are advised to take one of three options in regards to the animal: vaccinate; observe under formal or informal quarantine; or euthanase.

If a domestic animal which has been bitten or scratched by a bat subsequently bites or scratches a human, an expert panel may be convened to advise on management, at the discretion of the managing public health officer. If post-exposure prophylaxis is to be offered to human contacts in any situation involving domestic animals which have suffered bites or scratches from bats, in the absence of a defined human exposure (i.e. bite, scratch or mucous membrane exposure) to the bat, or laboratory confirmed lyssavirus infection in the animal, an expert panel should always be convened. Consultation with animal health colleagues may be indicated. .

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## 14. Appendices

Appendix 1. Vaccine booster dose algorithm for protection against rabies virus or other lyssaviruses

Appendix 2. Post-exposure management algorithm for potential exposure to rabies virus from a terrestrial animal overseas

Appendix 3. Post-exposure management algorithm for potential exposure to lyssaviruses from bats in Australia or overseas

Appendix 4. Rabies virus and other lyssaviruses (including ABLV) post-exposure prophylaxis form

Appendix 5. Rabies virus and other lyssaviruses (including Australian bat lyssavirus) fact sheet

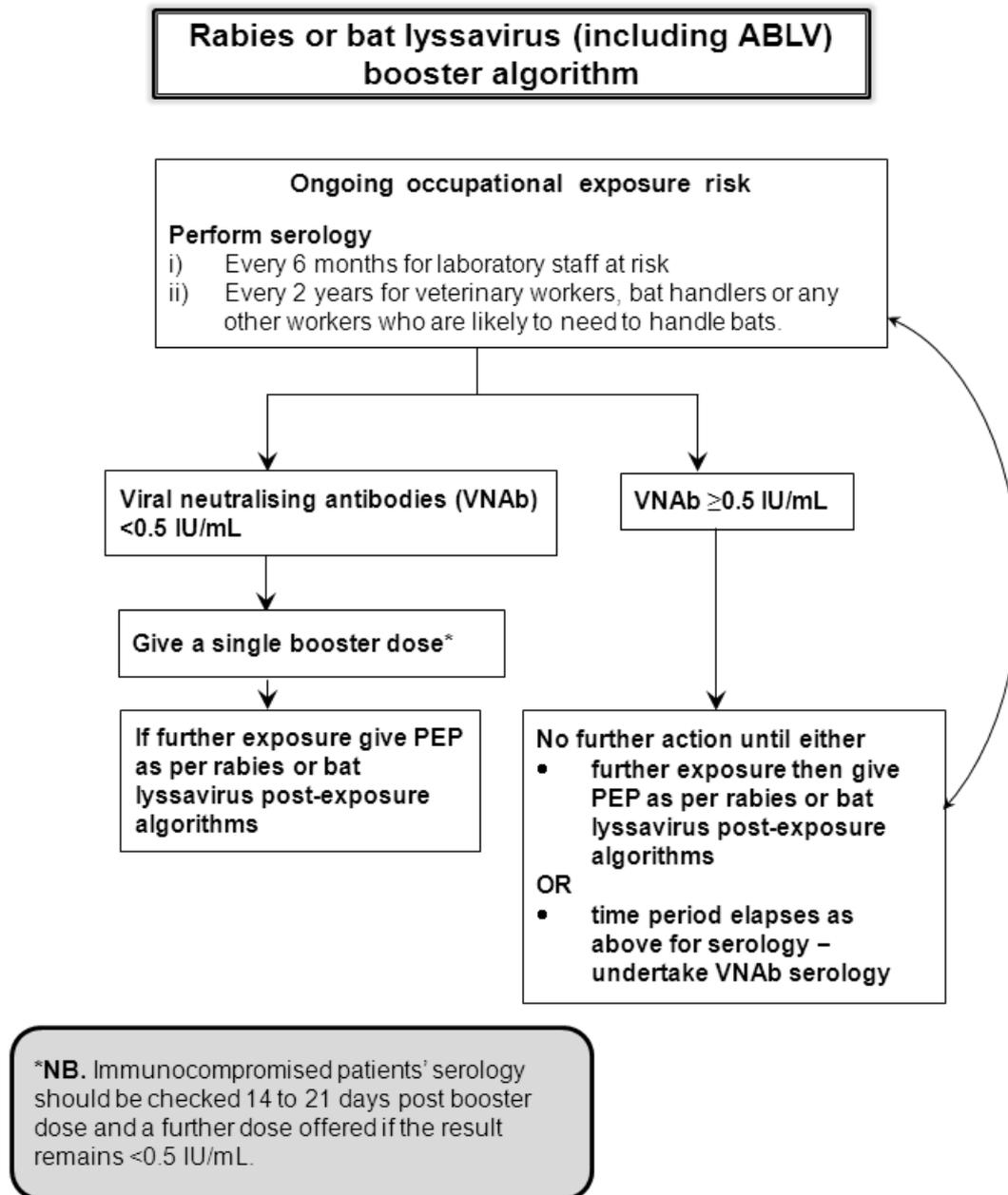
Appendix 6. PHU rabies virus and other lyssaviruses (including ABLV) follow-up checklist

## **15. Jurisdiction specific issues**

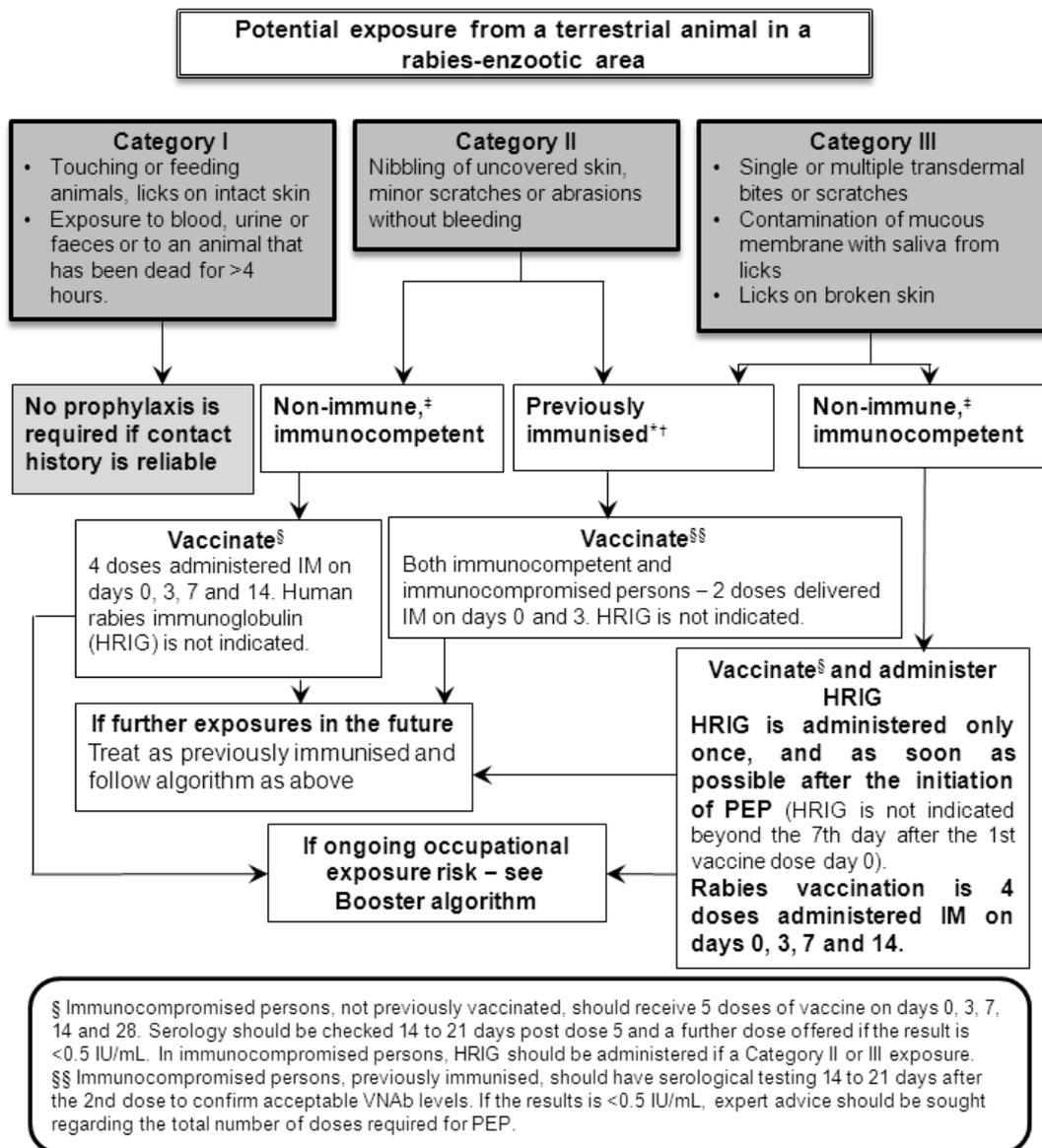
Information on State and Territory Public Health Legislation, the Quarantine Act 1908 and the National Health Security Act 2007:

<http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-state-legislation-links.htm>

## Appendix 1. Vaccine booster dose algorithm for protection against rabies virus or other lyssaviruses



**Appendix 2. Post-exposure management algorithm for potential exposure to rabies virus from a terrestrial animal overseas This algorithm can also be used for the management of exposures to terrestrial mammals in Australia that are confirmed to have lyssavirus infection.**

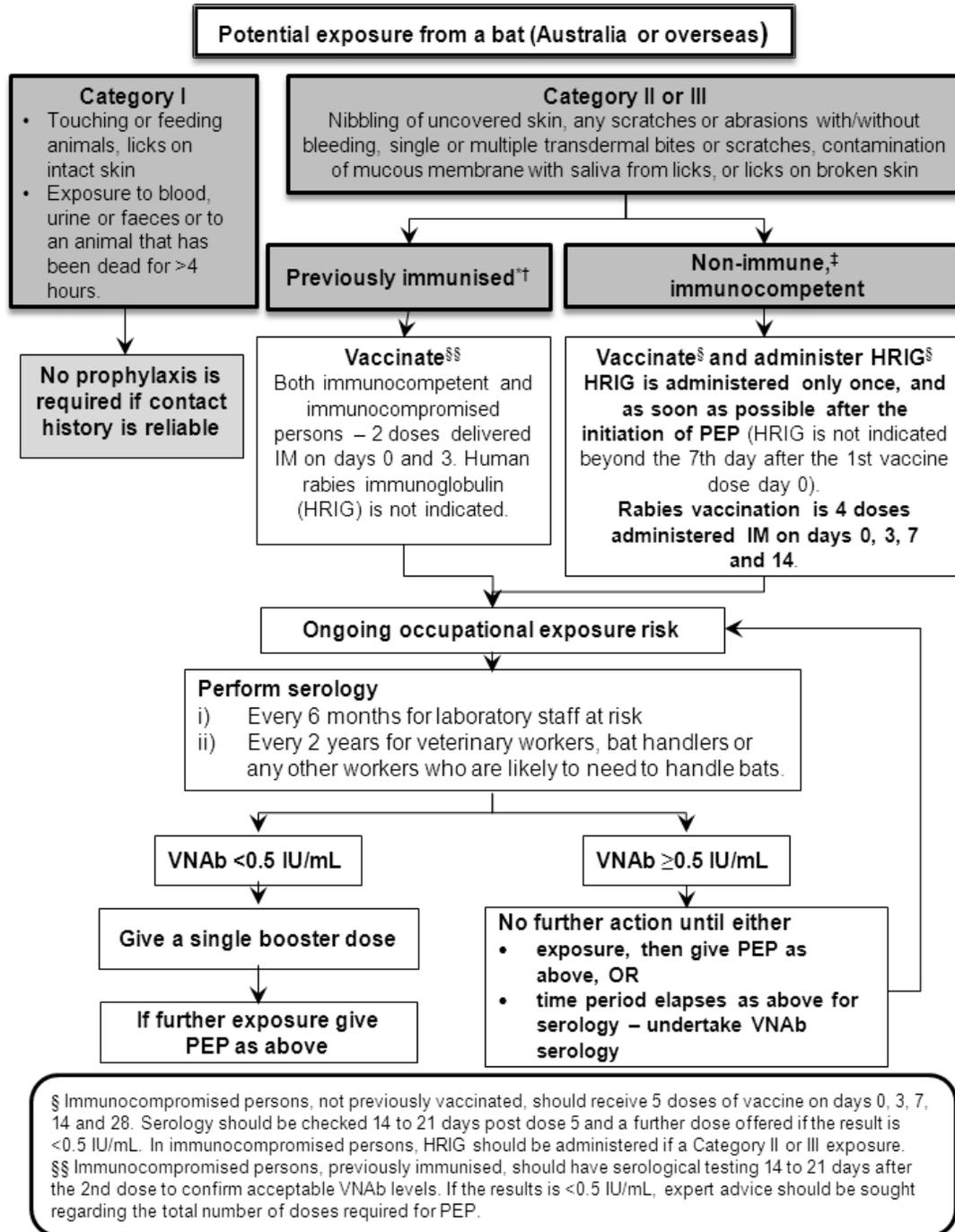


\* If in doubt, treat as non-immune.

† Previously immunised – documentation of a completed recommended PreP or PEP rabies vaccine regimen. This is irrespective of the time period since the last dose was administered. This may either be a completed primary pre-exposure course or post-exposure course and includes those where subsequent boosting has occurred, or documented rabies antibody (VNAb) titres of  $\geq 0.5$  IU/mL.

‡ Non-immune – person who has never received pre- or post-exposure immunisation with rabies vaccine, has had incomplete/inadequate primary vaccination course, or if any doubts about the vaccine(s) administered overseas

### Appendix 3. Post-exposure management algorithm for potential exposure to lyssaviruses from bats in Australia or overseas



\* If in doubt, treat as non-immune.

† **Previously immunised** – documentation of a completed recommended PreP or PEP rabies vaccine regimen. This is irrespective of the time period since the last dose was administered. This may either be a completed primary pre-exposure course or post-exposure course and includes those where subsequent boosting has occurred or documented rabies antibody (VNAbs) titres of ≥ 0.5 IU/mL.

‡ **Non-immune** – person who has never received pre- or post-exposure immunisation with rabies vaccine or has had incomplete/inadequate primary vaccination course

## Appendix 4. Rabies virus and other lyssaviruses (including ABLV) post-exposure prophylaxis form

<b>RABIES VIRUS and OTHER LYSSAVIRUSES (including ABLV) POST EXPOSURE ASSESSMENT</b>	
<b>Case details</b>	ID no. _____
Name: _____ Sex M F	Date of birth ___/___/___
Address: _____	Phone: _____
Indigenous status: Aboriginal ___ Torres Strait Islander ___ Aboriginal and Torres Strait Islander ___ Non-indigenous ___ Unknown ___	
<b>Person Notifying</b>	
Name _____	Fax _____
Clinic/hospital name (if relevant) _____	
Address _____	Telephone _____
Suburb _____ State _____	Postcode _____
<b>Exposure</b>	
Date of exposure _____	Time of exposure _____
Type of wound	Bite Scratch Lick Saliva Other _____
Wound/exposure location _____	
Was the skin broken?	Y N U Depth/Severity _____
Did the wound bleed?	Y N U _____
Animal: Dog Cat Monkey Bat	Type..... Other Specify.....
Was the animal:	Wild Domestic Unknown
Did the animal appear unwell?	Y N U <i>If yes, describe:</i> _____
Was the animal provoked?	Y N U <i>Describe incident:</i> _____
Is the animal's owner/home known?	Y N U
When was the animal last seen alive? (date) ___/___/___	Animal's vaccination status, if known _____
If tested, was the animal positive for rabies virus or another lyssavirus?	Y N U
<i>If yes, provide details:</i> _____	
Where did exposure occur? ( <i>geographic location-as precise as possible</i> ) _____	
Country _____	

### Case history

Did the case receive the wound during occupational (including volunteering) activity?

Y N U

Did the case spend more than a month in a rabies enzootic area? Y N U

Was the case working with mammals in a rabies enzootic area? Y N U

Did the case work with live lyssavirus in a laboratory? Y N U

Previous rabies vaccination? Y N U Doses \_\_\_\_\_ Date of last dose \_\_\_\_\_

Which vaccine? \_\_\_\_\_

Was immunoglobulin given? Y N U Date \_\_\_\_\_

Describe treatment of wound following incident: \_\_\_\_\_

Is the case immunocompromised? Y N U *If yes, details* \_\_\_\_\_

### Treatment details (in Australia)

Date wound assessed \_\_\_/\_\_\_/\_\_\_

Who assessed the wound? GP ED PHU Health Service Other \_\_\_\_\_

*RIG* Date administered \_\_\_/\_\_\_/\_\_\_ Weight of case \_\_\_ kg amount used \_\_\_ mL

*Vaccine* Date of first dose \_\_\_/\_\_\_/\_\_\_ Doses required \_\_\_\_\_

Who will provide PEP (*if different to person notifying*) Name \_\_\_\_\_

Fax \_\_\_\_\_

Clinic/hospital name (if relevant) \_\_\_\_\_

Address \_\_\_\_\_ Telephone \_\_\_\_\_

Suburb \_\_\_\_\_ State \_\_\_\_\_ Postcode \_\_\_\_\_

### Jurisdictional contact

Name \_\_\_\_\_ Fax \_\_\_\_\_

Address \_\_\_\_\_ Telephone \_\_\_\_\_

Suburb \_\_\_\_\_ State \_\_\_\_\_ Postcode \_\_\_\_\_

## **Appendix 5. Rabies virus and other lyssaviruses (including Australian bat lyssavirus) fact sheet**

### **Rabies virus and other lyssaviruses (including Australian bat lyssavirus)**

#### ***What are rabies virus and other lyssaviruses such as Australian bat lyssavirus?***

Rabies virus and Australian bat lyssavirus (ABLV) belong to a group of viruses called lyssaviruses. These viruses are usually transmitted via a bite from an infected (“rabid”) animal. They all cause a similar illness known as rabies, which affects the central nervous system and is usually fatal. The World Health Organization estimates that more than 55 000 people die from rabies worldwide each year. Rabies virus does not currently occur in land dwelling animals in Australia. However, ABLV, which is closely related but not identical to rabies virus, does occur in Australia, and can be transmitted from bats to humans. Only three cases of human infection with ABLV have been recorded since the virus was first identified in 1996. All three cases were in Queensland and all died as a result of ABLV infection after being bitten or scratched by bats.

#### ***What are the symptoms?***

The early symptoms of rabies are flu-like, including headache, fever and fatigue. The illness progresses rapidly to paralysis, delirium, convulsions and death, usually within a week or two of the onset of illness. There is a wide variability in the time it takes for symptoms to appear following exposure to an infected animal (from several days to several years).

#### ***How are they spread?***

Rabies virus and other lyssaviruses (including ABLV) are spread from infected animals to people through bites or scratches, or by being exposed to infected animals’ saliva through the eyes, nose or mouth. Only mammals can be infected. Overseas, dogs are the main transmitter of rabies. Other animals that transmit rabies overseas include bats, monkeys, foxes, cats, raccoons, skunks, jackals and mongooses.

In Australia, evidence of ABLV infection has been found in various species of flying foxes/fruit bats and insect-eating microbats. **It is assumed that any bat in Australia could potentially carry ABLV.** The behaviour or appearance of a bat is not an accurate guide as to whether it is carrying the virus. Lyssaviruses are unlikely to survive outside a bat or other animal for more than a few hours, especially in dry environments that are exposed to sunlight. Contact or exposures to bat (or other animal) faeces, urine or blood do not pose a risk of exposure to lyssaviruses, and nor do living, playing or walking near bat roosting areas. Apart from two horses, no wild or domestic animals in Australia have ever been found to be infected with ABLV.

#### ***Who is at risk?***

People who handle bats in Australia or overseas, and people who come into contact with wild or domestic land dwelling mammals in a country where there is a rabies virus risk, are at increased risk of rabies.

### ***How is it prevented?***

The best protection against being exposed to rabies or other lyssaviruses (including ABLV) is to avoid handling any bat in Australia or overseas, or any wild or domestic land dwelling mammal in a country where there is a rabies virus risk. This includes wild or domestic dogs, cats, and monkeys. Only people who have been vaccinated against rabies and who have been trained in the care of bats should ever handle bats or flying foxes. Anyone who comes across an injured bat should contact the relevant state government authority or a local wildlife care group or rescuer for assistance. Do not touch the bat and avoid direct contact with any bat saliva.

Rabies vaccine is used to protect against infection with rabies virus and other lyssaviruses (including ABLV). A course of three injections, given over one month, is recommended for people whose job or other activities place them at increased risk of being bitten or scratched by bats in Australia or overseas, or land dwelling mammals in countries where there is a rabies virus risk. Periodic booster doses of vaccine may also be required. If you intend to work in or travel to a country or countries where there is a rabies virus risk, you should discuss with your doctor whether you should be vaccinated. This will depend on the period of time you will be away, the risk of animal bites, and how easy it would be to access emergency medical attention if bitten or scratched.

If you are bitten or scratched by a bat anywhere in the world or by a land dwelling mammal overseas, you should:

- immediately wash the wound thoroughly with soap and water for at least five minutes - proper cleansing of the wound reduces the risk of infection
- apply an antiseptic with anti-virus action such as povidone-iodine, iodine tincture, aqueous iodine solution or alcohol (ethanol) after washing
- seek medical attention as soon as possible to care for the wound and to assess whether you are at risk of infection

If you are at risk of infection and have not been vaccinated previously, you will require an injection of rabies immunoglobulin as soon as possible and a series of either four or five rabies vaccine injections over one month. Even if you have been vaccinated before, you will require two further doses of vaccine. The relevant Australian state or territory health department will fund these vaccines and arrange for them to be delivered to your GP or hospital in Australia. Rabies immunoglobulin is often difficult to obtain in overseas countries but vaccine is usually available.

If the animal or bat can be tested without placing other people at risk of exposure, vaccination may be delayed for up to 48 hours. In Australia, testing of bats can be arranged by the local public health unit. If the bat does not have ABLV, the course of vaccinations will not be required, or can be ceased.

### ***How is it diagnosed?***

Diagnosis requires confirmation by laboratory tests for the presence of lyssaviruses in skin, blood, spinal fluid and nervous tissue.

### ***How is it treated?***

There is no available treatment for rabies once symptoms have started.

***What is the public health response?***

Doctors should contact their local public health unit for advice on people bitten or scratched by animals, including bats, that could transmit rabies or other lyssaviruses. Public health unit staff will help arrange vaccination following exposure and rabies immunoglobulin where required.

Hospitals and laboratories will notify cases of rabies to the local public health unit. Public health unit staff will investigate the likely source and determine whether others may be at risk of infection.

***Further information***

For further information, please contact your local doctor or nearest public health unit.

## **Appendix 6. PHU rabies virus and other lyssaviruses (including ABLV) follow-up checklist**

Patient ID number: \_\_\_\_\_

### **1. If potential exposure to rabies or other lyssaviruses (including ABLV):**

#### **Contact the exposed person (or care-giver) to:**

- Identify source and circumstances of potential exposure, including identification of bat species if possible
- Determine if any other persons or animals were exposed to same animal/bat
- Determine if animal/bat available for testing and arrange testing where appropriate
- Review exposed person's vaccination status and immune competence, and discuss need for post-exposure treatment (PET) and prophylaxis (PEP) and if they have a preferred doctor to manage provision of PET
- Provide with *Rabies Factsheet*

#### **Contact exposed person's doctor to:**

- Discuss need for PET, including wound management and provision of PEP
- Complete *Rabies virus and other lyssaviruses (including ABLV) post-exposure prophylaxis form*
- Arrange for timely delivery of vaccine and HRIG to doctor, as appropriate

#### **Contact laboratory to:**

- Facilitate animal testing, where appropriate. In Australia, this may require liaison with jurisdictional animal health authorities to arrange handling and transport of the animal to a laboratory with capacity to test for lyssaviruses.

#### **Other issues:**

- Report details of exposure, PET and animal testing to state/territory communicable diseases branch
- Enter exposure data into NetEpi and/or jurisdictional database, as appropriate

### **2. If rabies case:**

#### **Contact the patient's doctor to:**

- Obtain patient's history
- Confirm results of relevant pathology tests
- Recommend that the tests be done if need be

#### **Contact the patient (or care-giver) to:**

- Confirm onset date and symptoms of the illness
- Identify likely source of exposure including type of animal/bat and type of exposure
- Determine if any other persons/animals were exposed to same animal/bat
- Provide with *Rabies Factsheet*

#### **Contact laboratory to:**

- Obtain any outstanding results

**Confirm case**

- Assess information against case definition

**Other issues:**

- Report details of case to state/territory communicable diseases branch and senior managers as appropriate
- Enter case data onto notifiable diseases database