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## 1.0 GOAL

The goal of the provincial Rabies Control Program is to prevent the acquisition of human rabies. Prevention of human rabies disease is undertaken through:

- Evaluation of human exposure to animals for the risk of rabies transmission.
- Provision of post-exposure immunoprophylaxis to persons exposed or potentially exposed to rabies virus.
- Provision of pre-exposure immunization of persons at increased risk of exposure to rabies virus.
- Collaboration and consultation with provincial and federal animal health authorities regarding rabies incidence and control in British Columbia in domestic and wild animals.

The intent of this guideline is to provide direction on:

- Risk assessment (including determining the rabies status of animals involved in an exposure).
- Risk management (post-exposure prophylaxis).
- Pre-exposure prophylaxis for individuals that may be at risk due to occupational or anticipated travel to an endemic area for lengthy periods.
- Reporting exposures.
- Ordering biologicals.

## 2.0 DEFINITIONS

**Direct contact:** contact with a rabid or potentially rabid animal whereby rabies virus present in undessicated saliva or neural tissue could be introduced through contact with eyes or mucous membranes, or through a break in the skin by means of a bite or scratch.

**Enzootic:** consistently present in an animal population (equivalent to endemic in human population).

**Epizootic:** greater than expected occurrence in an animal population (equivalent to epidemic in human population).

**RPEP:** Rabies post-exposure prophylaxis is accomplished through the administration of rabies immune globulin (Rablg) and/or rabies vaccine. Rablg provides rapid, short-term protection. Rabies vaccines contain inactivated virus and induce an active immune response beginning 7 to 10 days post-immunization.

**Terrestrial mammal:** Mammals that live predominantly or entirely on land (e.g., cat, raccoon, fox). Bats are NOT considered terrestrial mammals.



### WHO categories of contact with suspect rabid animals:

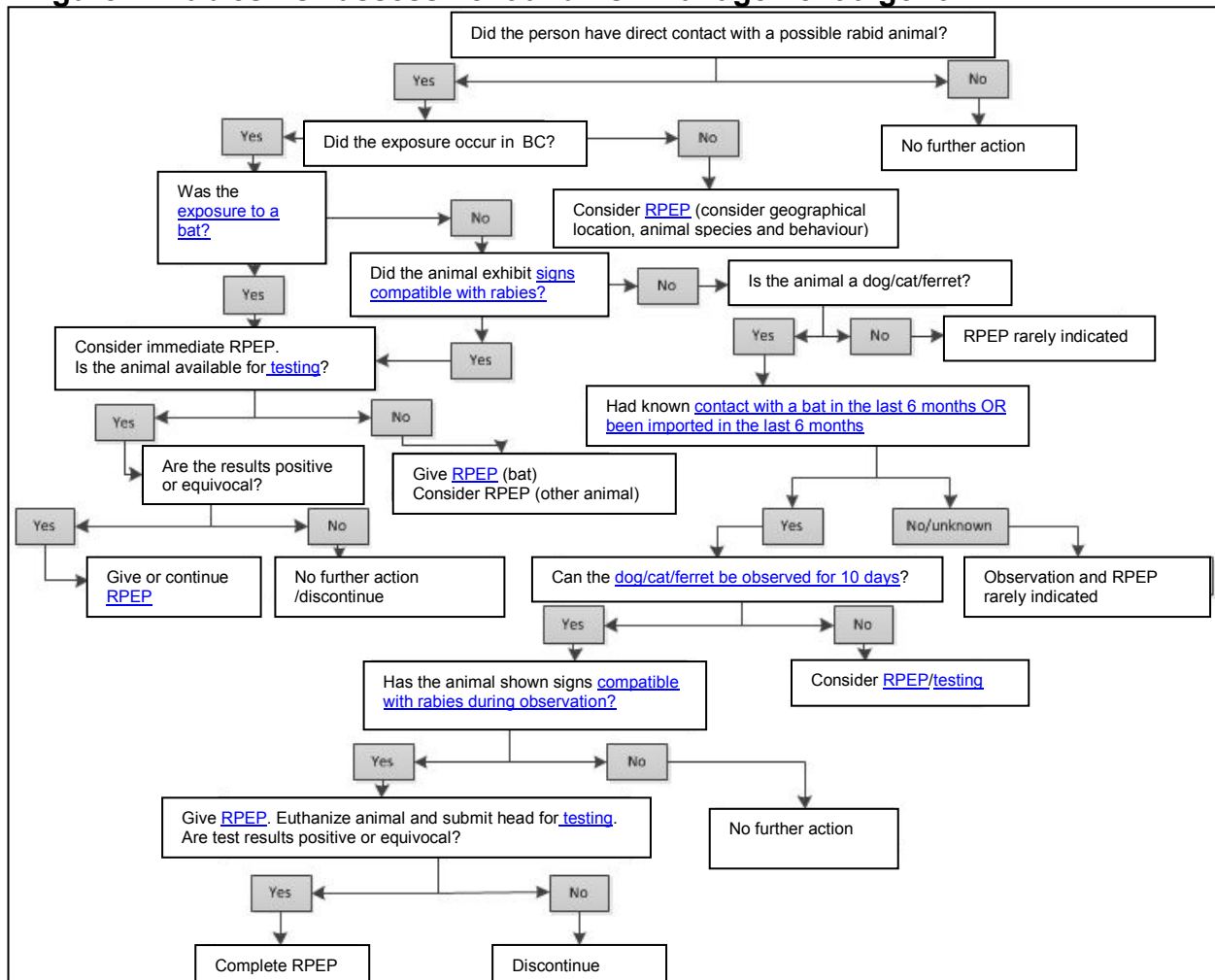
(<http://www.who.int/mediacentre/factsheets/fs099/en/>)

- Category I: touching or feeding animals, licks on intact skin
- Category II: nibbling of uncovered skin, minor scratches or abrasions without bleeding
- Category III: single or multiple transdermal bites or scratches, licks on broken skin, contamination of mucous membranes with saliva from licks, [direct] contact with bats

### 3.0 RISK ASSESSMENT

The following algorithm is a quick guide to determine the need for rabies post-exposure prophylaxis (RPEP). Supporting information follows.

Figure 1. Rabies risk assessment and risk management algorithm





### 3.1 Exposure History

Direct contact (see the definition in [Section 2.0](#)) with a potentially rabid animal is necessary for transmission of the rabies virus.

When assessing the risk of rabies, the following need to be considered:

- Animal species ([Tables 1A and 1B](#), [Section 3.1.1](#) and [Section 3.1.2](#))
- Geographic location ([Tables 1A and 1B](#) and [Section 3.1.2](#))
- Animal behaviour ([Section 3.1.3](#))
- Animal rabies vaccination status ([Section 3.1.4](#))
- Type of exposure (bite vs. other) ([Section 3.1.5](#))
- Body part exposed ([Section 3.1.6](#))



**Table 1A. Summary of rabies risk assessment and management for exposures in BC**

Risk level:	Very high	High	Medium	Low	Very Low
<b>Species and risk factors</b>	<b>Bats</b> Risk further elevated if: •Bite (vs scratch) •Exposure to face/head or hand •Signs compatible with rabies	<b>Wild or domestic mammal with signs compatible with rabies<sup>1</sup></b>	<b>Wild or domestic mammal</b> •Imported from a rabies-endemic area in last 6 months AND/OR •Known bat contact in last 6 months, particularly if unvaccinated	<b>Wild or domestic mammal</b> with no known risk factors	<b>Rodents and lagomorphs</b> with no known risk factors
<b>Action following direct contact AND saliva exposure not ruled out</b>	Consider immediate RPEP. May be discontinued if animal tested and shown to be negative.		For a dog, cat, ferret: Consider observing/ confining if possible for 10 days; give RPEP if animal exhibits signs compatible with rabies. <sup>1</sup> If no observation possible and for other species: RPEP rarely indicated.	RPEP rarely indicated	RPEP almost never indicated

**Table 1B. Summary of rabies risk assessment and management for exposures outside BC**

Risk level:	Very high	High	Medium	Low	Very Low
<b>Species and risk factors</b>	<b>Bats</b> anywhere  <b>Dogs</b> in enzootic countries  <b>Wildlife</b> in enzootic areas	<b>Wild or domestic mammal</b> not known to be a reservoir species <b>with signs compatible with rabies.<sup>1</sup></b>  <b>Wild monkeys<sup>2</sup></b> with or without signs of rabies	<b>Wild or domestic mammal</b> with no known risk factors		<b>Rodents and lagomorphs</b> with no known risk factors
<b>Action following direct contact AND saliva exposure not ruled out</b>	Consider immediate RPEP. May be discontinued if animal tested and shown to be negative.		Dog, cat, ferret: Observe if possible and give RPEP if animal exhibits signs of rabies. <sup>1</sup> If no observation possible and for other species: case-by-case basis <sup>3</sup>		RPEP almost never indicated

<sup>1</sup> The clinical diagnosis of rabies should be made by a veterinarian. Signs are variable; the most reliable are behavioral changes, neurological signs and progressive paralysis. Behavioral changes include loss of appetite, signs of apprehension or nervousness, irritability, hyperexcitability and uncharacteristic aggressiveness. Neurological signs include loss of coordination, altered phonation, profuse salivation, inability to swallow, seizures and paralysis. (Rupprecht 2011, Merck & Co. Inc. 2016)

<sup>2</sup> If a macaque monkey bite or scratch occurred, please refer to Simian B virus guidelines.

<sup>3</sup> Action is based on discussion with public health professionals in location of exposure, where possible.



Bats are a rabies reservoir worldwide. Various terrestrial mammals may be a reservoir depending on the region of the world.

### 3.1.1 Bats

Bats are the only known rabies reservoir in BC. These recommendations apply to all bat exposures that occur in BC or globally.

For bat exposures, intervene (testing and/or RPEP) when both of the following conditions apply:

- There has been direct contact with a bat ([Section 2.0](#)); AND
- A bite<sup>4</sup>, scratch or saliva exposure into a wound or mucous membrane cannot be ruled out ([NACI 2009](#)).

Evidence for direct bat contact may include observation of physical contact, verbal history of physical contact. Consult the NACI statement on bat behaviour and exposure ([NACI 2009](#)).

In children and other people whose histories are less reliable (cannot accurately report bites or scratches), any direct contact with a bat may require RPEP. While clothing may act as a barrier to direct contact, it can also mask exposure. NACI recommends that children who have contact with a bat through clothing may require RPEP because their histories are less reliable ([NACI 2009](#)).

RPEP is not indicated if there is no history of direct contact; for example, if a bat was found in the house, or if someone woke up with a bat in the bedroom, without any evidence it touched someone.<sup>5</sup> When a bat is found in the room with a child or an adult who is unable to give a reliable history, assessment of direct contact can be difficult. Factors indicating that direct contact may have occurred include the individual waking up crying or upset while the bat was in the room or observation of the bat in close proximity to the individual (e.g., in or on the bed).

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<sup>4</sup> Bat bites and scratches can be difficult to see due to small bat teeth and nails.

<sup>5</sup> The risk of rabies in the absence of recognized physical contact with bats is exceedingly small. A Québec survey found that ~0.1% of the population may be exposed annually to a bat in the bedroom while they are sleeping ([De Serres 2009](#)). However, only a minority (<5%) of these individuals eligible for RPEP sought advice and received RPEP.

There have been 56 non-organ transplant related bat-variant rabies cases in Canada and the US in 1950-2007 (3.9/1 billion person-years) with only 6 of those in Canada ([De Serres 2008](#)). Thirty-one (55%) had direct contact with a bat, 6 (11%) found bats in their home and 19 (34%) reported no bat exposure at all. Among those with a bat found in their home, 2 reported bats in their bedroom while sleeping and the other 4 reported bats in the home either while sleeping or close to the time they may have been exposed.

Of the 11 cases with a history of a bat in the bedroom, 9 reported being bitten or awoken by the bat landing on them and 2 reported no direct contact. The number needed to vaccinate to prevent a single case of rabies from bat-in-bedroom exposures is 2.7 million at a cost of \$2.1 billion ([De Serres 2009](#)).



The clinical diagnosis of rabies should be made by a veterinarian.<sup>1</sup> For questions related to bat behaviour and rabies signs in bats, MHOs can consult with the BC Wildlife Veterinarian or the Wildlife Health Biologist (see [Appendix A](#) for contact information). If a bat is available and there has been no human exposure, the BC Wildlife Veterinarian may be interested in testing the bat for bat diseases. Please discuss with the veterinarian.

### 3.1.2 Terrestrial Mammals

#### 3.1.2.1 BC

In BC, terrestrial mammals are not known to be reservoirs of rabies. However, they may on rare occasions be infected with the bat strain of rabies (see Reservoir in [Section 5.0](#)). If a domestic animal has been imported from, or travelled out of BC to an area where rabies is enzootic within the last 6 months, it may have been exposed to rabies and should be assessed accordingly.

Many wild animals may act aggressively when approached by a human or a predatory animal (including dogs), particularly if they are protecting their young, are food conditioned or habituated to humans or have no ability to escape the situation. Bites and scratches from these animal encounters are not rare in urban and suburban settings.

The clinical diagnosis of rabies should be made by a veterinarian.<sup>1</sup> For further questions related to wild animal behaviour and rabies signs in animals, MHOs can consult the BCCDC Public Health Veterinarian, the BC Wildlife Veterinarian or the Wildlife Health Biologist (see [Appendix A](#) for contact information).

#### 3.1.2.2 Outside BC

##### Wild animals

Rabies is enzootic to varying degrees in wild animals in Canada east of the Rockies and in other countries. Consider skunk, raccoon, coyote, bobcat, fox and other wild animals to be rabid unless tested and shown to be negative (except in rabies-free countries).<sup>6</sup>

Monkeys may be infected with rabies and may transmit rabies virus to humans ([Gautret 2014](#)). Although the prevalence of rabies in wild monkeys is low and human cases are rare, given it is usually not possible to test wild monkeys in other countries, exposures should lead to RPEP ([Table 1B](#)).

##### Domestic animals (pets and livestock)

In some countries, domestic animals are enzootic for rabies or are regularly infected with rabies. Dog bites provide the greatest risk of rabies transmission in most developing countries. Consider RPEP on an individual basis, taking into account the

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<sup>6</sup> For animal rabies activity in Canada see [Rabies in Canada](#).



behaviour of the animal and the geographic location. The risk is higher in Asia and Africa<sup>7</sup>.

### Rodents and lagomorphs

Rabies is extremely rare in small rodents and lagomorphs (rabbits and hares). No action is normally needed with exposure to these species, unless unusual behaviour of the animal warrants it. Exceptions include woodchucks found to be rabid in parts of the US in association with raccoon rabies expansion and the occasional report of an infected rodent in other parts of the world ([Moro 1991](#), [Childs 1997](#), [Kamoltham 2002](#), [Wang 2009](#)). However, no rodent-human transmission of rabies has been reported.

#### 3.1.3 Animal behaviour

The signs of rabies infection can vary considerably between species and individual animals. An animal exhibiting behaviour that is considered unusual for that particular species could potentially be rabid. Entering an animal's territory or close interactions, especially hand feeding, could be considered provocation. When an animal attacks for no known reason or has no history of aggression, this would be considered an unprovoked attack.

The clinical diagnosis of rabies should be made by a veterinarian.<sup>1</sup> For questions related to animal behaviour, MHOs can consult the BCCDC Public Health Veterinarian (see [Appendix A](#) for contact information).

If an animal had physical contact with a rabid animal (e.g., a cat played/fought with a bat which is later determined to be rabid) and then had direct contact with an individual, it is unlikely that rabies would be transmitted. There are no known incidents of rabies transmission by such indirect contact. The minimum time for animal rabies to incubate is 2 weeks; transmission of rabies will not occur until the virus is being shed in the animal's saliva.

#### 3.1.4 Vaccination status of animal

A domestic animal which has been vaccinated against rabies routinely<sup>8</sup> is likely protected from rabies<sup>9</sup>. However, if the animal behaviour is highly unusual, the animal may need to be observed or euthanized regardless of vaccination status.

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<sup>7</sup> In 2000-2010, the total human rabies deaths due to domestic animal exposure outside of Asia and Africa was 19. For Asia and Africa, for the years 2000-2002 and 2003-2009 the total was 2,177. ([aWHO 2010](#)) For information on the risk of rabies in other countries, consult the WHO publication "[International Travel and Health](#)". To help assess the risk in specific countries, refer to the WHO [map](#).

<sup>8</sup> Depending on the vaccine, a booster needs to be given every 1-3 years ([NASPHV 2011](#)). Consult a veterinarian to assess how often the particular vaccine needs to be given.

<sup>9</sup> The majority of vaccinated domestic animals are considered protected. However, a small proportion (about 5%) are not protected or can become rabid through overwhelming viral challenge, incomplete vaccine efficacy, improper vaccine administration or host immunocompromise ([NASHPV 2011](#), [Murray 2009](#), [Jakel 2008](#), [Kennedy 2007](#)).





### 3.1.5 Type of exposure

In a potentially infected animal, the following body substances/tissues may be infectious:

- Saliva and salivary glands
- Neural fluid and tissue

As such, the highest risk exposure is from the bite of an infected animal that breaks the skin. Scratches from an infected animal can theoretically introduce rabies virus if, for example, the animal had licked its nails prior to the scratch. In practice, very few cases of human rabies have been reported secondary to this route of transmission ([Afshar 1979](#)).

Virus can rarely be found in urine, muscle and lungs. Contact with such materials has not been documented to lead to transmission of rabies. There is a theoretical risk of airborne transmission of rabies virus from bat feces ([Brown 1971](#), [Heymann 2008](#)). RPEP should only be considered for an aerosol exposure where the number of bats in an enclosed area is very high, the exposure is prolonged and the appropriate personal protective equipment was not used. As viremia has not been detected in infected animals, blood is generally considered non-infectious.

### 3.1.6 Human body part exposed

Exposure to the face and hands increases the risk of rabies because these body parts are highly innervated, providing greater and faster opportunity for virus to enter the nervous system. Although the distance of the exposed body part to the brain affects the incubation period, it does not affect the time available to provide RPEP (i.e., once the virus enters the peripheral nervous system, RPEP is no longer of use).

## 3.2 Observation and Testing of Animals

### 3.2.1 Observation of dogs, cats and ferrets which have potentially exposed humans to rabies

Healthy dogs, cats and ferrets which have exposed humans can be observed for 10 days. The rationale is that rabies virus is excreted in a rabid animal's (dogs, cats, ferrets) saliva for a few days prior to and during illness.<sup>10</sup> If the animal is clinically well after 10 days, it was not shedding rabies virus and is deemed non-infectious at the time of the exposure and can be released from confinement/observation.

The decision to confine and/or observe the animal rests with the EHO and/or MHO and is based on the level of risk. Animal bites are not reportable in BC and the majority go

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<sup>10</sup> The period of salivary excretion in an infected cat, dog or ferret starts a few days prior to or early after the onset of symptoms ([Vaughn 1963](#), [Vaughn 1965](#), [Niezgoda 1998](#)). Only one study of dogs experimentally infected with rabies virus showed 1/16 dogs with viral excretion longer than 10 days prior to symptom onset (13 days prior) ([Fekadu 1982](#)).



unreported. The risk of rabies transmission from terrestrial animals in BC is extremely low. However, if a dog, cat or ferret bite comes to the attention of public health authorities, the following criteria can assist in determining if observation or other action should be considered:

- local epidemiology of rabies for associated animal species
- assessment of animal provocation
- animal rabies vaccination status (if applicable)
- abnormal behaviour or neurological signs in the animal
- animal had prior known contact with a bat within the last 6 months
- animal is known to have been imported within the last 6 months from an area where rabies circulates in terrestrial mammals (including other provinces/territories).

Observation should be considered even if the animal has been vaccinated.<sup>11, 12</sup> If the owner is not available for questioning or the animal is not available for observation (e.g., stray/feral or euthanized), risk management actions (i.e., observation, testing, RPEP) are made at the discretion of the MHO on a case-by-case basis. Given the low risk of rabies in terrestrial animals in BC, observation or other action is rarely indicated.

The EHO/MHO asks the owner to keep the animal in the home/on the property and to observe for signs of rabies. The owner is asked to call the EHO/MHO if signs of rabies occur.<sup>1</sup> If the animal displays signs of rabies during observation, it must be taken to a veterinarian for assessment and euthanasia without injury to the brain and the brain shipped to the Canadian Food Inspection Agency (CFIA) laboratory and tested for rabies.

Under normal circumstances, animals should not be vaccinated during the observation period in order to avoid confusing rare adverse reactions with clinical signs of rabies. Uncommonly, an animal is both potentially exposed to rabies and bites a human. In this rare circumstance, rabies vaccine should be administered to the animal immediately.<sup>12</sup>

The incubation period and period of rabies virus shedding in other animal species are not clearly known, and therefore observation of other animal species does not apply.

If a BC resident is exposed to a dog, cat or ferret in another country, and the animal can be confined and observed for 10 days, the MHO may determine that RPEP is not needed in the BC resident under certain circumstances<sup>13</sup>, such as:

- the animal remains well after 10 days and
- the animal is an indoor pet and

<sup>11</sup> There is insufficient evidence to support post-exposure prophylaxis of animals ([NASPHV 2011](#)).

<sup>12</sup> Recommendations of the Canadian Council of Chief Veterinary Officers Subcommittee for the Management of Potential Domestic Animal Exposures to Rabies (2015).

<sup>13</sup> This recommendation and considerations were determined by consensus by the Rabies Guidelines Revision WG (2014).



- the animal has been vaccinated and is up to date on boosters.

If RPEP was already started in the BC resident exposed in another country, see [Section 4.2.1](#).

### 3.2.2 Testing and observation of domestic animals which have potentially been exposed to rabies by other animals

*The information in this section is taken from the BC Rabies Guidance for Veterinarians and is for public health information only.*

If a domestic animal has had physical contact with an animal suspected of having rabies (including any bats), the domestic animal's private veterinarian will conduct a risk assessment of rabies transmission based on the species involved, the animals' behaviours and the type of exposure. Consultation with the BCCDC Public Health Veterinarian is available for assistance with animal-to-animal exposures (see [Appendix A](#) for contact information).

- A. Exposures deemed at no risk need no further action.
- B. For domestic animal exposures assessed by the veterinarian to pose a risk of rabies transmission and in which the **exposed domestic animal is currently vaccinated**, the private veterinarian should provide a rabies vaccine booster to the exposed animal within a 7 day window of the exposure event. No further action is required.

In cases where a booster vaccination is not administered within 7 days, a booster vaccination should still be administered as soon as possible after the exposure event. The private veterinarian, together with the Public Health Veterinarian, will make decisions about further actions (e.g., need for isolation and observation) on a case-by-case basis based on the exposure event and age, health status and vaccination history of the exposed domestic animal. In most cases, an animal that is currently vaccinated at the time of exposure will not require isolation, even if administration of the post-exposure booster vaccination is delayed until after 7 days.

- C. For animal exposures assessed to pose a risk of rabies transmission and in which the **exposed domestic animal is unvaccinated**, the private veterinarian should:
  - a) Vaccinate the exposed domestic animal within a 7 day window of the exposure event. In cases where a booster vaccination is not administered within 7 days, a booster vaccination should still be administered as soon as possible after the exposure event.
  - b) If the suspect animal (e.g., the bat) is available, offer to have it tested. If testing is agreed upon, the private veterinarian coordinates the suspect animal's euthanasia (if required), sampling (if required), packaging and shipment to the CFIA Animal Disease Research Institute (ADRI) in Lethbridge, Alberta.



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- i) If the suspect animal tests negative, no further steps are recommended.
  - ii) If the suspect animal is unavailable or tests positive, the private veterinarian can recommend:
    - (1) euthanasia of the exposed domestic animal OR
    - (2) for the owner to isolate and observe the domestic animal on the owner's property AND for the owner to consult their veterinarian if the animal exhibits changes in behavior or health that indicate signs of rabies. The recommended isolation and observation period is 90 days for animals that receive a rabies vaccine within 7 days of the exposure event, and 180 days for animals that do not receive a rabies vaccine or that receive a rabies vaccine more than 7 days after the exposure event.
- D. For animal exposures assessed to pose a risk of rabies transmission and in which the **exposed domestic animal is previously vaccinated, but out of date**, the private veterinarian should:
- a) Vaccinate the exposed domestic animal within a 7 day window of the exposure event. In cases where a booster vaccination is not administered within 7 days, a booster vaccination should still be administered as soon as possible after the exposure event.
  - b) If the suspect animal (e.g., the bat) is available, offer to have it tested. If testing is agreed upon, the private veterinarian coordinates the suspect animal's euthanasia (if required), sampling (if required), packaging and shipment to the CFIA Animal Disease Research Institute (ADRI) in Lethbridge, Alberta.
    - i) If the suspect animal tests negative, no further steps are recommended.
    - ii) If the suspect animal is unavailable or tests positive, the private veterinarian, together with the Public Health Veterinarian (PHV), will make decisions about further actions (e.g., isolation and observation) on a case-by-case basis based on the exposure event and age, health status and vaccination history of the exposed domestic animal.
      - (1) In most cases when the exposed animal is administered a booster vaccine within 7 days, no isolation and observation period would be necessary.
      - (2) In cases where a booster vaccination is not administered within 7 days, the private veterinarian, together with the PHV, will make decisions about further actions (e.g., need for isolation and observation) on a case-by-case basis based on the exposure event and age, health status and vaccination history of the exposed domestic animal. In most cases, a 90 day isolation and observation period would be required.

### 3.2.3 Testing of animals which have potentially exposed humans

Any animal suspected of having rabies which has exposed a human through direct contact as defined in [Section 2.0](#) should be tested for rabies, if possible.



If an animal dies of natural causes after exposure (and/or during observation), strong consideration should be given to testing it (there is an increased risk it may have died of rabies). If an animal is killed after it has exposed someone (e.g., shooting of an aggressive wild animal), it can be tested.

### Specimen collection

When there has been no direct contact, bats should not be captured or tested, since an attempt to capture a bat may increase the risk of direct contact. Since no RPEP is recommended if there is no contact, there is no point in testing such bats.

In situations where there is evidence of direct contact with a bat and salivary exposure cannot be ruled out, and the bat is available for testing, refer the client to a wildlife specialist or pest control company in the area to capture it. If a specialist is not available, do **not** encourage someone who was not exposed to try and capture the bat, thus increasing their risk of exposure.

If the person **already exposed** is willing, have them:

- Close all doors and windows in the area, put on a hat, leather gloves, a long-sleeved jacket and pants.
- Use a blanket, net, broom or towel to catch the bat (without touching it and while protecting any exposed area such as the face). Use tongs to put it in a container with air holes. Place the container in a cool, safe place away from human or pet contact.
- Not kill the bat.
- Contact the public health unit for further instructions.

For animals which have exposed humans, EHOs will coordinate the specimen collection, packaging and shipment. The person/agency conducting the specimen collection, packaging and shipment depends on the animal species, its status (dead or alive) and geographical considerations ([Table 2](#)). Regardless of who conducts the collection, packaging and shipment, the local Health Authority should be informed that a sample was submitted for rabies testing. EHOs and other public health staff should not handle live animals suspect of having rabies. EHOs handling a dead animal suspect of having rabies should wear gloves.

**Table 2. Options for collection and shipment of various animal specimens**

Animal species and status	Collection and shipment
Bat, dead or alive	Exposed person, wildlife biologist, conservation officer or animal control staff brings to vet for euthanasiation (for live bats), vet packages and ships or contacts EHO who packages and ships
Other wildlife, alive	Conservation officer or animal control staff kills animal and takes to a vet (wildlife or private) to have head removed; vet packages and ships or contacts EHO who packages and ships
Other wildlife, dead	Conservation officer or animal control staff takes to a vet (wildlife or private) to have head removed; vet packages and ships or contacts EHO who packages and ships
Domestic animals, alive	Animal owner takes animal to private vet for euthanasiation and head removal if necessary; vet packages and ships or contacts EHO who packages and ships
Domestic animals, dead	Animal owner takes animal to private vet for head removal if necessary; vet packages and ships or contacts EHO who packages and ships

**Specimen submission**

Testing of animals for rabies in cases of human and domestic animal exposure for WHO contact categories II or III ([see Section 2.0 for definitions](#)) is available without charge at the CFIA Animal Disease Research Institute (ADRI), Lethbridge, Alberta (phone number 403-382-5500).<sup>14</sup>

The specimen has to be appropriately packaged and shipped and the submission form has to be completed [Appendix B](#). Details on packaging and shipment of specimens are found in [Appendix C](#). Ensure shipment of the specimen to the ADRI occurs within 48h. The turnaround time for results on rabies testing is up to 72h.

Acceptable samples are non-decomposed, non-fixed, undamaged brains that allow the excision of the medulla oblongata (including pons), hippocampus and cerebellum. This includes whole animal brain extracted, animal head including brain if the whole body will not fit into the shipping container, or for small animals, the entire carcass (e.g., bats, which also allows for species identification).

A portion of spinal cord should be added when the brain is severely damaged, when the specimen is from a large animal (e.g., elk, bear, cow or horse), or when the animal was

<sup>14</sup>When there is interest in testing an animal which has not exposed a human or a domestic animal, the Animal Health Centre (AHC) in Abbotsford can provide free testing. The AHC offers an immunohistochemistry screening test; if this is positive, the specimen is submitted to CFIA for free confirmation.



killed at a suspected early stage of the disease (Kush J; Wandeler A; personal communication, 2009).<sup>15</sup>

## 4.0 RISK MANAGEMENT

### 4.1 First Aid

Wash with a mild soap and flush the wound with copious amounts of water under moderate pressure. Expert opinion suggests washing should be done for at least 15 minutes ([NACI 2015](#)). This is extremely important and evidence shows that effective wound first aid can significantly reduce rabies risk ([Dean et al. 1963](#)). Some authorities recommend disinfecting the wound with an iodine-containing or alcohol solution or other topical virucidal disinfectant to further decrease the viral load ([NACI 2015](#)).

The wound should not be sutured unless indicated for cosmetic or tissue support reasons. Sutures, if required, should be placed after local infiltration of Rablg. They should be loose and not interfere with free bleeding and drainage ([Heymann 2008](#)).

As appropriate, follow-up wound care should be undertaken by a physician. Although the risk of rabies may be small, there is a risk of other infections at the wound site. Tetanus-diphtheria vaccination should be updated as required and administration of antibiotics should depend on the clinical picture.

### 4.2 Rabies Post-Exposure Prophylaxis (RPEP)

If the risk assessment suggests a high or very high risk of rabies exposure, consider providing immediate RPEP ([see Tables 1A and 1B](#)). Expert opinion recommends that if RPEP is indicated, it should not be delayed beyond 48 hours<sup>16</sup> while waiting for the results of testing ([NACI 2015](#)). NACI deemed this timeframe provides a reasonable balance between the risk of transmission and obtaining further information to guide risk management. However, the decision to wait for test results, regardless of the time it takes, should be based on the level of risk (see [Section 3.1](#)).

RPEP consists of one dose of rabies immune globulin (Rablg) and a series of rabies vaccine (see the [BC Immunization Manual, Part 4: Biological Products, Rabies Vaccine](#)

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<sup>15</sup> In some instances, the fluorescent antibody test may not be obviously positive, and examination of neural tissue further down the brain stem may be necessary. This is especially true if an animal has been killed in the early stages of the disease, before the virus has an increased concentration in the brain. A sample taken from the brain of a larger animal is somewhat less likely to capture virus than if it is taken from the spinal cord, where the concentration of virus is greater (Kush, J; personal communication Nov 10, 2010).

<sup>16</sup> The recommendation that RPEP should not be delayed more than 48h while awaiting results was based on expert opinion of the NACI rabies working group members in 2012. If rabies exposure is considered highly likely, NACI recommends RPEP should be started as soon as possible after exposure ([NACI 2015](#)). The 48h timeframe was selected based on a number of factors balancing the risk of rabies and the need for further information; it is not solely reflective of incubation period.



for [POST-EXPOSURE Prophylaxis](#) for doses and schedules):

- **Unimmunized immunocompetent individuals:** 3 doses of two-site ID vaccine on days 0, 3, and 7 or 4 doses of IM vaccine on days 0, 3, 7, and 14 ([NACI 2015](#), [WHO 2018](#)).<sup>17</sup> RabIg (20 IU/kg body weight) is given on day 0 at the same time as the first dose of vaccine, or within 7 days of the first vaccination. Every effort should be made to administer doses on time ([NACI 2015](#)).

If necessary, the route of administration can be changed once.<sup>18</sup> When switching the route, a fourth dose of vaccine should be provided on or after day 14.

Serological confirmation of immunity is recommended following completion of the rabies vaccine series for all those immunized with the three-dose ID regimen (Figure 2)<sup>19</sup>. Provision of RIG results in a maximum mean serum concentration of 0.13 IU/mL ( $\pm$  0.02 IU/mL) and is not expected to interfere with serological assessment of vaccine response (HyperRAB® product monograph).

- **Unimmunized immunocompromised individuals and those taking chloroquine or hydroxychloroquine:** Such individuals should be immunized with a series of 5 doses of IM vaccine. RabIg (20 IU/kg body weight) should be administered on day 0, or within 7 days of the first vaccination. Every effort should be made to administer doses on time ([NACI 2015](#)).

Serological confirmation of immunity is recommended 7-14 days following completion of the rabies vaccine series for those on high doses of steroids or immunosuppressed at the time of immunization. If the rabies antibody titre is below 0.5 IU/mL, a 2<sup>nd</sup> series of rabies vaccine should be given via the IM regimen. If the titre remains below 0.5 IU/mL, the Medical Health Officer should be consulted for a risk assessment for further management.

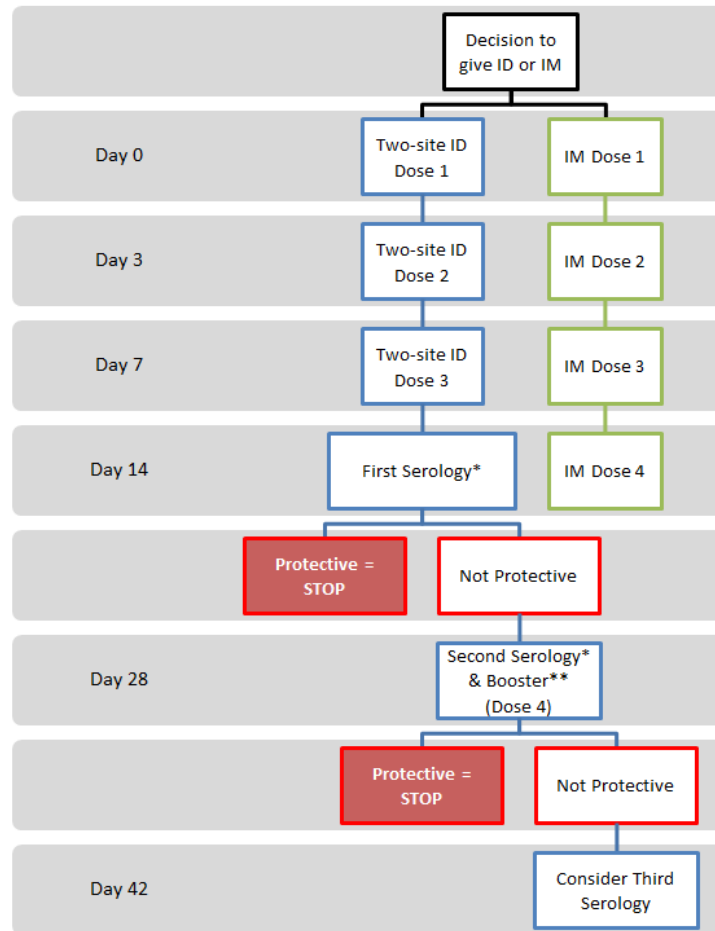
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<sup>17</sup> NACI recommends an RPEP dosage of 1 dose of rabies immune globulin and a series of rabies vaccine as specified in the [BC Immunization Manual, Part 4 – Biological Products, Rabies Vaccine for POST-EXPOSURE Prophylaxis](#). This approach is based on evidence that the most critical element of prophylaxis is the rapid administration of RabIg and the first dose of vaccine. Many countries use the WHO-approved Zagreb regimen of RabIg plus a series of 2-1-1 vaccine doses. ([Rupprecht 2009](#), [NACI 2012](#)).

<sup>18</sup> A small study consisting of 47 RPEP recipients who received a 4-dose mixed regimen of ID and IM administrations showed 100% seroprotection and no evidence of RPEP failure following a category III exposure in an enzootic setting ([Ravish 2014](#)). WHO recommendations also allow for a switch in the route of administration ([WHO 2014](#)).

<sup>19</sup> Draw serum sample and submit with [requisition](#) to the BCCDC Public Health Laboratory (PHL). Consultation is available with the BCCDC PHL Lab Supervisor at 604-707-2828 or Medical Microbiologist on call at 604-661-7033. BCCDC PHL forwards sample to the National Microbiology Laboratory. Allow for 5-10 days turnaround time.





\* Use the [Zoonotics Diseases & Emerging Pathogens Requisition for the BCCDC Rabies Dose Study](#)

\*\* Ensure serology is obtained prior to administration of the booster dose

**Figure 2:** Decision-tree and schedule for obtaining serology following three-dose intradermal administration of rabies vaccine for post-exposure prophylaxis of immunocompetent individuals. **In the event that serology does not demonstrate protection, the booster dose (dose 4) should be given using the Two-site ID regimen.** Serology is not required for a four-dose IM vaccine series.

Rablg should be infiltrated in every wound site ([WHO 1992](#)).<sup>20</sup> If necessary, Rablg can be diluted using the appropriate diluent for the product being used as described in the [BC Immunization Manual, Part 4 – Biological Products](#), Immune Globulins, Rabies Immune Globulin (Rablg) to ensure there is sufficient volume to infiltrate all wounds; if there is no obvious wound or there is too much Rablg to infiltrate the wound, any

<sup>20</sup> Rablg provides passive protection in the days prior to the stimulation of innate antibody production by vaccination (7-10 days after initial dose). Infiltration of every wound is recommended to neutralize the virus before it enters the nerves where antibodies cannot reach it. Intramuscular injection of Rablg does not provide adequate serological protective antibody levels to neutralize the virus ([Dean 1963](#), [Chomchay 2000](#)). The vast majority of recent reports of RPEP failure had incomplete or no Rablg infiltration of wounds; this has been identified as the major factor in RPEP failure ([Wilde 1996](#), [Wilde 2007](#)).



remaining Rablg should be administered IM at a site distal to the vaccination site.<sup>21</sup>

RPEP should be offered to exposed individuals regardless of the elapsed interval since exposure. The longest incubation periods for rabies have been reported to be 6 years ([Smith 1991](#), [Johnson 2008](#)).

#### 4.2.1 RPEP Started in Other Countries

When travellers are exposed to an animal in a rabies-enzootic country, they are advised to obtain detailed, written information on the type of Rablg and vaccine they have received, the vaccination schedule and routes of administration. It would also be advisable to obtain a label of the biologicals.

For various reasons, the RPEP received may not be adequate.<sup>22</sup> In determining the value of biologicals administered overseas, a case-by-case assessment must be made:

- Assess the risk of rabies
  - Based on rabies epizootology and WHO category of contact (see [Section 2.0](#)) assess the risk of rabies exposure, where possible
- Assess whether regulated products and WHO-approved schedules were used ([Section 4.5](#)), and administered via appropriate routes and sites
  - Review available information on the products used, dosage and route of administration from:
    - the client (e.g., written documentation such as product label, receipts and medical documents)
    - other sources (e.g., internet, product monograph)
  - Review the location of the medical assessment and RPEP provision (a developed region or country, a hospital, a clinic listed with the International Society of Travel Medicine, etc. are more likely to use regulated products and approved schedules and to maintain the cold chain<sup>23</sup>)
- Review previous BC experience with the international biologicals provided (i.e. BC data showing that previous travellers having received the same product from the same clinic/region/country have mounted an adequate serological response).<sup>24</sup>

<sup>21</sup> Based on a 2017 literature review, 1) there is no information on the duration of time after an exposure during which Rablg remains effective in decreasing the risk of infection and 2) it is not possible to determine where the virus is between the wound and the CNS at any given point in time. It is therefore recommended that Rablg be given whenever RPEP is warranted.

<sup>22</sup> RPEP provided in some countries may be inadequate for various reasons such as compromised cold chain, non-WHO approved vaccine or schedule, counterfeit vaccine or lack of Rablg. There are occasional media reports of counterfeit vaccines being sold or used in certain countries. Counterfeit vaccine has been reported in China (several times) and the Philippines (2013). There are rare reports of vaccine failures associated with these products. There is little information on how widespread the practice is (Wandeler A, Meslin FX, Rupprecht CE personal communication, 2008). As of 2008, there was no WHO-approved Rablg available in China, apart from Hong Kong ([Davis 2008](#)).

<sup>23</sup> All WHO-approved rabies vaccines are stable at 37°C for at least 1 month ([WHO 2006](#)).

<sup>24</sup> These data would be available regionally in clinical documents or provincially through linking serological testing results and epidemiological data.



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**If RPEP needs to be continued or re-started in BC**

- 1) If the RPEP series begun in another country is deemed valid by the MHO, continue the series in Canada.

In general, the local risk assessment and decision can be accepted unless there is overwhelming evidence to the contrary, as local health authorities are more likely to know the local rabies epidemiology.

If a valid vaccine series was started overseas, the series can be completed with another vaccine licensed in Canada ([aWHO 2010](#)). If a different, but WHO-approved dosing schedule ([Section 4.5](#)) was used overseas, attempt to continue with this schedule. If the schedule used is not WHO-approved consider re-initiation of the series.<sup>25</sup>

If no Rablg was administered, provide Rablg if within 7 days of first vaccine dose. If more than 7 days have passed since the first dose of vaccine, do not provide Rablg.<sup>26</sup>

- 2) If the validity of the RPEP series given or begun in another country is in question ([WHO 2008](#) and [CATMAT 2002](#)):
  - A. Consider drawing serum for rabies antibody titres.<sup>27,28</sup>
  - B. Start a new series of RPEP.
    - Provide a complete vaccine series if the validity of the vaccine series is in question.
    - The decision to provide Rablg should be made on a case-by-case basis.<sup>29</sup>
      - If the person has NOT received Rablg within 7 days since the first dose of a valid vaccine, provide Rablg.
      - If the person has NOT received Rablg and a non-WHO approved vaccine was administered, consider providing Rablg

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<sup>25</sup> There is no evidence for or against this. This recommendation is based on expert opinion.

<sup>26</sup> Such a vaccine course should induce an antibody response. Rablg will not be useful if given more than 7 days after the first dose of vaccine and may decrease the vaccine antibody response.

<sup>27</sup> Draw serum sample and submit with requisition to BCCDC PHL (<http://www.elabhandbook.info/PHSA/Default.aspx>). Under "Viruses", check "Other" and add "rabies titre". Under History, add "Partial/full rabies post-exposure prophylaxis received". Start the vaccine series while awaiting lab results. Consultation is available with the BCCDC PHL Lab Supervisor at 604-707-2828 or Medical Microbiologist on call at 604-661-7033. BCCDC PHL forwards sample to the National Microbiology Laboratory. Allow for 5-10 days turnaround time.

<sup>28</sup> Caution is required when interpreting rabies antibody titres if Rablg has been administered. If a valid dose of Rablg has been administered, rabies antibody titres may not be helpful in decision-making as titres will remain high for several months, regardless of the validity of vaccines administered. A complete series of vaccines provided in Canada may still be required.

<sup>29</sup> Rablg can partially suppress the immune response to rabies vaccine ([Wiktor 1971](#)). The recommended dose of Rablg should not be exceeded and doses should not be repeated. The half-life of Rablg is 21 days ([Loofbourow 1971](#)). Rablg received more than three months prior to the administration of vaccine should no longer be present in the serum.



- regardless of time elapsed since the first dose of vaccine.
- If the person received Rablg of questionable validity, consider providing another dose of Rablg.
- C. If the titre returns an Ab level of  $\geq 0.5$  IU/mL and the client has had a complete series of vaccinations, the new series of vaccinations can be discontinued.<sup>28</sup> If the titre is  $< 0.5$  IU/mL, the series of vaccinations started in Canada should be completed.

### 4.3 RPEP in Persons Previously Immunized Against Rabies

If a person has completed a course of rabies pre/post-exposure prophylaxis at any time in the past using a WHO approved rabies vaccine and schedule ([Section 4.5](#)) OR has had a rabies antibody titre  $\geq 0.5$  IU/ml at any time in the past:

- Do not give Rablg
- Give two doses of IM rabies vaccine on day 0 and day 3

If a new exposure occurs and a previous RPEP or pre-exposure prophylaxis (PrEP) regimen was given in the last 3 months, there may not be a need to repeat RPEP ([SAGE 2017](#), [Sudarshan 2011](#)).<sup>30</sup> This should be assessed on a case-by-case basis, taking into account the risk of rabies ([Section 3.1](#)) and the validity of the previous regimen received ([Section 4.2](#)). Wound washing and wound care is still required ([Section 4.1](#)).

If a person has completed a course of rabies pre/post-exposure prophylaxis using a non-WHO approved vaccine or schedule, consider as unimmunized and provide RPEP ([Section 4.2](#)). In immunocompromised individuals, provide a complete series of 5 doses of IM rabies vaccine and 1 dose of Rablg ([Section 4.2](#)).<sup>31, 32</sup>

### 4.4 Pre-Exposure Rabies Prophylaxis (PrEP)

Pre-exposure rabies immunization is elective and should be offered to persons at potentially increased risk of contact with rabid animals ([Table 3](#)). Refer to the BC Immunization Manual, Part 4 – Biological Products, [Rabies Vaccine for PRE-EXPOSURE Prophylaxis](#) for details regarding vaccine administration. In BC, pre-exposure rabies vaccine is provided free only to BC students attending a Canadian Veterinary College or Animal Health Technology Training Centre.

<sup>30</sup> [Sudarshan et al. 2011](#) conducted a literature review and found that the vast majority of people who received RPEP or PrEP via ID or IM route had antibody titres  $> 0.5$  IU/mL up to 3 months post-vaccination and were considered to still be immune.

<sup>31</sup> NACI recommends a complete course of vaccine and Rablg only if titres are  $< 0.5$  IU/ml ([NACI 2012](#)). However, titre results are not available until 5-10 days after serum is drawn which is not sufficient to assist in decision-making. A consensus was reached by the BC Communicable Disease Advisory Policy Committee in April 2013 to recommend this course of action.

<sup>32</sup> There is no evidence to support or refute this. This is based on expert opinion.



**Table 3: Pre-exposure Rabies Immunization**

<b>Personal Risk Category</b>	<b>Nature of Risk</b>	<b>Typical Populations</b>	<b>Pre-exposure Immunization</b>
<b>Very low risk</b>	Rare exposure to virus Potential for mucous membrane, bite or non-bite exposure.	BC population at large, Environmental Health Officers or other public health staff handling potentially rabid dead animals and most travellers to enzootic areas not in any of the higher risk groups below.	No immunization necessary.
<b>Low risk</b>	Exposure to virus nearly always episodic with source recognized. Potential for mucous membrane, bite, or non-bite exposure.	Veterinarians and staff, animal control and wildlife workers in areas of low rabies enzooticity (BC); veterinary and animal health technology students. Children and travellers visiting foreign enzootic areas for one month or more. Travellers to foreign epizootic areas, trekking/hiking for any length of time, and far from a major medical centre.	Initial series. Booster only following a subsequent exposure, or as determined by post-exposure serology.
<b>Moderate Risk</b>	Virus present episodically, with source recognized, but exposure may be unrecognized. Potential for mucous membrane, bite, non-bite or aerosol exposure.	Rabies diagnostic lab workers and spelunkers. Veterinarians and staff, animal control, wildlife biologists and wildlife workers in rabies enzootic areas. Hunters and trappers in high-risk areas such as the far north.	Initial series. Serologic testing every 2 years. Booster immunization when antibody level is < 0.5 IU/ml.
<b>High Risk</b>	Frequent exposure. Virus present continuously, often in high concentrations. Potential for mucous membrane, bite, non-bite or aerosol exposure. Specific exposures may go unrecognized.	Rabies research lab workers; rabies biologicals production workers; bat biologists.	Initial series. Serologic testing every 6 months. Booster immunization when antibody level is < 0.5 IU/ml

For immunocompetent individuals 18 years of age and older, pre-exposure prophylaxis can be given using either the intradermal (ID) or intramuscular (IM) regimen (see the [BC Immunization Manual, Part 4: Rabies Vaccine for PRE-EXPOSURE Prophylaxis](#)). Immunocompromised individuals, children less than 18 years of age, and those on chloroquine or hydroxychloroquine, or planning to start chloroquine within a month of series completion, should be immunized using the IM regimen. If the vaccine series is given via the ID regimen, antibody titres should be verified at least 14 days after completion of the vaccine series.<sup>33</sup> Antibody titres should also be verified for immunocompromised individuals.

<sup>33</sup> Draw serum sample and submit with requisition to BCCDC PHL (<http://www.elabhandbook.info/PHSA/Default.aspx>). Under "Viruses", check "Other" and add "rabies titre".



## 4.5 Rabies Vaccines and Schedules

WHO approves of the use of cell-culture and embryonated egg based vaccines. These include vaccines produced on human diploid cells (HDCV), fetal rhesus diploid cells, Vero (African green monkey kidney) cells (PVRV), primary Syrian hamster kidney cells, primary chick embryo cells (PCECV), and embryonated duck eggs (PDEV). Nerve tissue vaccines are less immunogenic and more reactogenic and are not WHO-approved ([CATMAT 2002](#), [aWHO 2010](#)). Individuals who have received them should be considered unvaccinated.

Each country's regulatory agency has approved certain rabies biologicals for use. In Canada, Health Canada has approved the following products for use:

- IMOVAX® Rabies (HDCV)
- RabAvert® (PCECV)

WHO pre-qualifies certain vaccines for use in countries and by agencies (e.g., UNICEF) that do not have regulatory capacity. The list of WHO pre-qualified vaccines is found at [http://www.who.int/immunization\\_standards/vaccine\\_quality/PQ\\_vaccine\\_list\\_en/en/](http://www.who.int/immunization_standards/vaccine_quality/PQ_vaccine_list_en/en/). It is updated regularly.

For all other countries, rabies biologicals are approved by in-country regulatory bodies. The quality of the regulatory process and the biologicals vary. If a BC resident receives such a product, its adequacy should be assessed on a case-by-case basis (see [Section 4.2.1](#)) recommended IM schedules include ([aWHO 2010](#))

- 5 dose schedule on days 0, 3, 7, 14 and 28
- 4 dose schedule with 2 doses on day 0 followed by 1 dose each on days 7 and 21
- 4 dose schedule on days 0, 3, 7 and 14

WHO-recommended ID schedule ([SAGE 2017](#)):

- 1 dose of 0.1 mL administered in two different body sites (0.1 mL per site, for a total of 0.2 mL at each visit) on days 0, 3, and 7.

## 4.6 Release of Biologicals for RPEP

Health units are encouraged to depot an appropriate quantity of rabies vaccine and Rablg based on demand from the previous year and any changes in RPEP guidelines. When the product dating is within 6 months of expiry and there is concern that product will not be used prior to expiry, return to BCCDC under cold chain conditions. Contact BCCDC Biologicals Desk at (604) 707-2582 to obtain authorization for this Field Return.

**The MHO must authorize all releases of rabies vaccine and Rablg.** Clinicians should call the MHO in their region for advice and release of biologicals (see [Appendix A](#) for contact information). MHOs can consult with BCCDC ([Appendix A](#)). On



establishing that RPEP should be administered, the MHO requests release of the appropriate biologicals from the local depot or from BCCDC.

If rabies biologicals are to be released from BCCDC, the MHO must use the [Rabies Biologicals Request Form](#). Fax the form to the BCCDC Biologicals Desk at (604) 707-2581 [phone number: (604) 707-2582]. This form must specify the required number of doses of vaccine and vials of Rablg. The dose of Rablg is calculated according to the person's body weight. Refer to the chart in [Appendix D](#). Personnel releasing the biologicals are not responsible for computing this information.

**For after-hours release of RPEP biologicals from BCCDC, the MHO needs to phone BCCDC Vaccine and Pharmacy Services on call after hours at 604-875-2161.**

The MHO may wish to provide an instruction sheet ([Appendix E](#)) to personnel who will be administering the RPEP series.

The HealthLink BC File [Rabies Immune Globulin and Vaccine](#) should be used for obtaining informed consent from the individual who will be receiving RPEP.

## 5.0 CLINICAL PRESENTATION IN HUMANS AND EPIDEMIOLOGY

**Clinical description:** The first signs of illness are non-specific and include fever, anxiety, and malaise. Often there is tingling and severe pruritus at the site of the animal bite. After 2-10 days, frank neurological signs appear, ranging from hyperactivity to paralysis. The disease is divided into encephalitic (“furious rabies”) and paralytic (“dumb rabies”) forms:

- In the encephalitic form, signs of irritation of the CNS predominate, including agitation, confusion, hydrophobia, aerophobia, hyperventilation, hypersalivation, priapism, and convulsions. After a few days to a week, the person may experience a stage of excitement that lasts only a few days before the person lapses into coma and death.
- The paralytic form of rabies differs in that the person does not experience a stage of excitement, but retreats steadily and quietly downhill, with some paralysis, to coma and death.

Once the virus enters the nervous system, treatment rarely affects the rapid progression to death. In 2004, a teenager who had not received RPEP developed rabies disease but survived following aggressive treatment ([Willoughby 2005](#)). This is the only known instance of survival following disease.

**Incubation period:** After inoculation, the virus may persist and replicate at the inoculation site for hours to weeks before progressing to nerve endings at the site of the bite. As the virus does not travel through the bloodstream or lymph system, it does not



readily induce an immune response prior to entering the nerves. Once the virus enters the nerves, it is virtually impossible to treat it. The virus slowly travels up the nerves to reach the CNS where it replicates and then disseminates through nerves to many body sites including the cornea, hair follicles, and salivary glands where there is further replication.

The incubation period is usually 3-8 weeks, rarely as short as a few days or as long as several years. The length of the incubation period depends on the severity of the wound, site of the wound in relation to the richness of the nerve supply and its distance from the brain, and the amount and strain of virus introduced ([Heymann 2008](#)).

**Infectious agent:** The rabies virus is a rhabdovirus belonging to the genus *Lyssavirus*.

**Mode of transmission:** Infection occurs by percutaneous introduction of the virus-laden saliva or CFS of a rabid animal through a bite or scratch, or into a fresh break in the skin, or by contact with intact mucous membranes. Transmission has been reported through the transplantation of organs taken from persons who died of undiagnosed rabies. Also, wild animals may bite and infect domestic animals which in turn may infect humans.

Airborne transmission has been reported in 2 instances in a laboratory setting, where there was significant aerosolization and possible lack of personal protection. Also, there have been 2 reports of rabies acquired in a bat infested cave attributed to aerosol transmission, but there is no proof in either case that a bite or wound contamination did not occur ([Irons 1957](#), [Humphrey 1960](#)). No well-documented natural transmission of rabies by aerosols has occurred ([Gibbons 2001](#)).

**Reservoirs:** In BC, bats are the only known reservoir. Since 2014, approximately 13% of the BC bats submitted for testing have tested positive for rabies (CFIA 2019). Bats submitted for testing have a higher likelihood of being infected. The true prevalence of rabies in BC bats is likely lower. Active surveillance of bats collected randomly in Alberta in 1979-1983 found 0.1% (1/769) tested positive for rabies ([Pybus 1986](#)).

There is occasional spill-over of bat-variant rabies to other species but no evidence of continued transmission within these species in BC:

- 2007 – a cat in Maple Ridge
- 2004 – 4 skunks in Stanley Park
- 1992 – 3 cats in Delta<sup>34</sup>
- Late 1980s – a beaver

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<sup>34</sup> Skunk strain of rabies virus was recovered from one of the Delta cats and the beaver. A wildlife survey in Delta (prior to 1989) following the isolation of the skunk strain rabies in a beaver, and intensified testing of cats following the Delta incident, indicated that the skunk strain of rabies is not enzootic in BC. The skunk strain identification has never been fully explained, although a lab error is possible. Strain testing was not available for the 1969 cat case, but it was most likely due to bat strain of virus.





- 1984 – a horse in the Sorrento area
- 1969 – a cat on Vancouver Island

In other parts of Canada, bats, skunks, raccoons and foxes may be reservoirs. In the developing world, dogs are a major source of infection, responsible for up to 99% of rabies deaths ([bWHO 2010](#)).

In all geographic jurisdictions, squirrels, hamsters, guinea pigs, gerbils, chipmunks, rats, mice and other rodents, rabbits and hares are only rarely infected with rabies. They are not known to have caused human rabies in North America.

**Human epidemiology:** In Canada, there have been 26 human cases reported since 1924 and 2 of these occurred in BC. Among them, a 25 year old male, Alberta resident was infected by a bat while in Alberta and died in BC in 1983. A 60 year old male BC resident was infected by bat variant rabies virus in BC and died in 2003 ([DeSerres 2008](#)) and a 21 year old male BC resident was infected following bat exposure in BC and died in 2019.

## 6.0 RECORDING AND REPORTING

Potential rabies exposures and the administration of RabIg and rabies vaccine are reported to monitor the occurrence of potentially rabid animal contacts, support rabies risk assessment, and monitor the utilization of RPEP in BC.

1. Record the incident/exposure history in the public health information system.  
**Only exposures leading to the provision of RPEP need to be reported.**

If Panorama is not utilized by the region where the exposed person resides, complete and email/fax the [Rabies Exposure Case Report Form](#) to the Communicable Diseases and Immunization Services (CDIS), BCCDC, at (604) 707-2516, where this information is entered into Panorama.

If the exposure occurs outside the Health Authority (HA) of residence, the HA conducting the follow-up should inform the HA of residence. The information should be entered by the HA of residence.

2. Next, record the administration of rabies vaccine and RabIg in the public health information system as per data entry standards.

There is no need to fax/email the [Record of Rabies Vaccine and Rabies Immune Globulin Administration](#) to the BCCDC.

If a non-public health site (e.g., hospital) is administering the RPEP, the HA should fax the [Record of Rabies Vaccine and Rabies Immune Globulin](#)



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[Administration](#) to the person who will be administering RPEP. Instruct this person to return the completed record back to the HA after RPEP has been administered. The HA then enters the data in the public health information system.

If the exposed client refuses RPEP or discontinues RPEP prior to completion, document this in the public health information system and inform the client's physician.

## 7.0 REPORTING AUTHORITY

Suspect and confirmed rabies is reportable by veterinarians to the BC Chief Veterinary Officer under the Reportable and Notifiable Disease Regulation of the provincial Animal Health Act. Rabies in animals is reportable by veterinarians to the CFIA under the Reportable Disease Regulations of the federal Health of Animals Act. Veterinarians fulfill their reporting requirements by submitting samples from a suspect animal to the CFIA laboratory for rabies testing.

Rabies in humans is reportable to the Medical Health Officer under the Public Health Act Communicable Disease Regulation (BC Reg 4/83), pursuant to the Public Health Act ([SBC 2008](#)) c. 28.



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**APPENDIX A: CONTACT INFORMATION**

<b>Agency</b>	<b>Position</b>	<b>Contact</b>
Fraser Health Authority	Central Communicable Disease Intake Line - Health Protection	1-866-990-9941
	Medical Health Officer (MHO) on call after hours	604-527-4806
Interior Health Authority	Communicable Disease Unit	1-866-778-7736
	MHO on call after hours	1-866-457-5648
Island Health Authority	South Island Communicable Disease Hub	1-866-665-6626
	Central Island Communicable Disease Hub	1-866-770-7798
	North Island Communicable Disease Hub	1-877-887-8835
	MHO on call after hours	1-800-204-6166
Northern Health Authority	Central Communicable Disease Hub	1-855-565-2990
	MHO on call after hours	250-565-2000
Vancouver Coastal Health	Communicable Disease Control	604-675-3900
	MHO on call after hours	604-527-4893
British Columbia Centre for Disease Control (BCCDC)	Physician Epidemiologist	604-707-2411
	Public Health Veterinarian	778-677-7790
	Physician on call after hours	604-875-2161
	Pharmacist on call after hours	604-875-2161
	Vaccines and biologicals desk	604-707-2582
Forests, Lands and Natural Resource Operations (FLNRO)	Wildlife Veterinarian	250-953-4285
	Wildlife Biologist	250-751-3219
Ministry of Agriculture	Chief Veterinary Officer	604-556-3013
	Public Health Veterinarian	778-666-0544



**APPENDIX B: CFIA RABIES SAMPLE SUBMISSION FORM<sup>35</sup>**

<input type="button" value="Go to first empty field"/> <input type="button" value="Submit"/> <input type="button" value="Clear"/> <input type="button" value="Print"/>																					
Canadian Food Inspection Agency / Agence canadienne d'inspection des aliments <b>DRAFT PROD - V1</b>																					
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The information you provide on this document is collected by (for) the Canadian Food Inspection Agency under the authority of Health of Animals Act. Personal information will be protected under the provisions of the Privacy Act and will be stored in Personal Information Bank CFIA/PPU 050. Information may be accessible or protected as required under the provisions of the Access to Information Act.  
 CFIA / ACIA 2908 (2013/12)  
 LSTIS-2908-EV1



<sup>35</sup> PDF form available at: [http://www.inspection.gc.ca/DAM/DAM-aboutcfia-sujetacia/STAGING/text-texte/c2908V1\\_re\\_1396296694437\\_eng.pdf](http://www.inspection.gc.ca/DAM/DAM-aboutcfia-sujetacia/STAGING/text-texte/c2908V1_re_1396296694437_eng.pdf). The BC Rabies Guidelines Revision WG suggests that Sample ID be the PH office or other location indicator (letters) followed by the date (numerical) (2014). For latitude and longitude of location of animal, use a website such as: <https://itouchmap.com/?r=latlong>.



## APPENDIX C – INSTRUCTIONS FOR SHIPMENT OF A RABIES SPECIMEN TO THE CFIA ADRI LAB

### Planning (prior to an exposure event)

- Review [CFIA guidance](#)
- Order gloves and packing supplies<sup>36</sup>
- Store freezer packs in freezer
- Preprint shipping labels
- As appropriate, ensure staff have training in Transportation of Dangerous Goods (TDG) (<http://www.tc.gc.ca/eng/tdg/training-menu-266.htm>).

### Preparation (when an animal needs to be submitted)

1. Follow the CFIA information sheet "[Rabies Testing at the CFIA: Packaging of Samples](#)".
2. Ensure animal is dead and sample is suitable:
  - Small animals (e.g., bats): submit entire carcass
  - Other: submit entire head or entire brain and cervical spinal cord if skull is damaged
  - Do not freeze specimen
3. Keep animal/sample in fridge prior to packaging.
4. Determine type of sample based on a risk assessment conducted on a case-by-case basis<sup>37</sup>:
  - Most samples will be "exempt animal specimens": animal specimens not believed to contain infectious substances
  - If there is a very high likelihood of rabies, the sample should be considered "biological substance, Category B": animal specimen believed to contain infectious substances<sup>38</sup>
5. Ensure the packager uses gloves to handle the animal specimen.
6. Complete the online Rabies Sample Submission form (see [Appendix B](#)). Refer to the CFIA information sheet [Rabies Testing at the CFIA: Completing the Electronic Submission Form](#).
  - Assign a unique identifier for the Sample ID.

<sup>36</sup> Packing supplies include bags, boxes, labels, freezer packs and absorbent material.

<sup>37</sup> Based on expert opinion (BC Communicable Disease Policy Advisory Committee, 2015), a decision on type of sample should be made on a case-by-case basis. There are risk and operational issues to consider. The type of sample affects labeling and courier selection but does not affect packaging; packaging should always follow TDG standards. The risk of transmission from a packaged specimen is deemed very low; if exposure did occur, effective RPEP is available. Most samples submitted from BC for rabies testing are not infectious (only 3-10% of submitted BC animals test positive). In other settings, diagnostic specimens are shipped using the Exempt category. Occasionally, the suspicion of rabies is high enough to warrant Biological Substance labeling and transportation. Operational considerations include whether the available courier can transport Biological Substances and whether TDG training and annual certification is feasible. More information can be found: <https://tc.canada.ca/en/dangerous-goods/transportation-dangerous-goods/training>.

<sup>38</sup> An infectious substance according to TDG is anything known or reasonably believed to cause disease.





- Prepare a label with this number in preparation for packaging.
7. If requiring weekend or holiday testing, certain criteria need to be met<sup>39</sup> and the request has to be discussed by phone with ADRI at 403-308-1131.

### Packaging

1. Place the specimen in the first bag and close tightly.
2. Attach a label with the Sample ID to the inner bag.
3. Wrap the bagged sample in absorbent material such as newspaper.
4. Place the first bag into a second bag and close tightly (for air transport, this bag must be pressure compliant).
5. Place bagged specimen in a box and add absorbent material and ice packs (in spring, summer and fall) to ensure the specimen remains cool.
6. Place the completed Rabies Sample Submission form in the box. Seal the box.

### Labeling

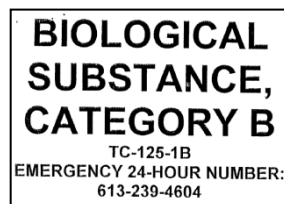
Addressee and shipper info needs to be on the box.

YOUR COMPLETE NAME YOUR EMPLOYER YOUR STREET ADDRESS CITY, PROVINCE, POSTAL CODE YOUR PHONE NUMBER	R-UNIT, LETHBRIDGE LABORATORY CANADIAN FOOD INSPECTION AGENCY TOWNSHIP ROAD 9-1 LETHBRIDGE, AB T1J 3Z4 (403) 382-5559
----------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------

Label box with shipping type:

- Biological substance, Category B or
- Exempt animal specimen

If “Biological Substance, Category B”, apply both of the following labels to box:



### Shipping

Specimens can be shipped by courier (e.g., Purolator, Fedex), air, bus or medical laboratory transport. Verify that the shipper can deliver to ADRI within 48h. If submitting over the weekend or during holidays, verify that the shipper delivers during weekends

<sup>39</sup> See [Rabies testing at the CFIA: Weekend/holiday testing](#).



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and holidays. If using Transportation of Dangerous Goods, verify that the shipper accepts infectious substances. The shipper's waybill should indicate "Biological Substance Category B UN3373" and the shipper should be TDG certified. If shipping an exempt animal substance, the shipper's waybill should indicate "Exempt Animal Substance".

**APPENDIX D: RABIES IMMUNE GLOBULIN (RABIG) DOSAGE BY BODYWEIGHT**

Rablg is available as **THREE** possible products with different concentrations:

- IMOGAM: 150 IU/mL (2 mL/vial)
  - Dose:  $\frac{[20 \text{ IU/kg} \times \text{weight in kg}]}{150 \text{ IU/mL}} = \underline{\hspace{2cm}}$  mL
- KamRAB: 150 IU/mL (2 mL/vial)
  - Dose:  $\frac{[20 \text{ IU/kg} \times \text{weight in kg}]}{150 \text{ IU/mL}} = \underline{\hspace{2cm}}$  mL
- HyperRAB: 300 IU/mL (1 mL/vial)
  - Dose:  $\frac{[20 \text{ IU/kg} \times \text{weight in kg}]}{300 \text{ IU/mL}} = \underline{\hspace{2cm}}$  mL

Prepare the amount of Rablg as calculated above (or refer to the table on the following page). Infiltrate as much Rablg as possible deep into and around the wound(s) in order to neutralize the virus. It may not be anatomically feasible to inject the maximum volume calculated above. Any remaining volume should be injected intramuscularly at a site distant from the vaccine. When more than one wound site exists, each site should be locally infiltrated with a portion of the Rablg using a separate syringe and needle for each infiltration. If there are extensive wounds, where the calculated dose of Rablg is **not** adequate in volume to infiltrate all wounds, the Rablg can be diluted using the appropriate diluent for the product being used as described in the [BC Immunization Manual, Part 4 – Biological Products](#), Immune Globulins, Rabies Immune Globulin (Rablg) to create an adequate volume to infiltrate all wounds. When there is no known wound site, the Rablg should be given into the exposed area.

Rablg should not be given in the deltoid unless it is the site of the exposure. Both deltoid muscles should be reserved for the administration of rabies vaccine.

**POST-EXPOSURE RABIES VACCINE:**

See the [BC Immunization Manual, Part 4: Rabies Vaccine for POST-EXPOSURE Prophylaxis](#) for the specified dose and schedule for those who are:

- unimmunized immunocompetent
- unimmunized immunocompromised
- taking chloroquine or hydroxychloroquine
- previously immunized



**Rabies Immune Globulin (Rablg) Dosage by Body Weight**

Weight		Dose	IMOGAM and KamRAB (150 IU/mL)	HyperRAB (300 IU/mL)
Pounds	Kilograms	IU	Dose (mL)	
10	4.5	91	0.6	0.3
12	5.4	109	0.7	0.4
15	6.8	136	0.9	0.5
20	9.1	182	1.2	0.6
22	10.0	200	1.3	0.7
25	11.4	227	1.5	0.8
30	13.6	272	1.8	0.9
35	15.9	318	2.1	1.1
40	18.2	363	2.4	1.2
45	20.4	409	2.7	1.4
50	22.7	454	3.0	1.5
55	25.0	499	3.3	1.7
60	27.2	545	3.6	1.8
65	29.5	590	3.9	2.0
70	31.8	636	4.2	2.1
75	34.1	681	4.5	2.3
80	36.3	726	4.8	2.4
85	38.6	772	5.1	2.6
90	40.9	817	5.4	2.7
95	43.1	863	5.8	2.9
100	45.4	908	6.1	3.0
105	47.7	953	6.4	3.2
110	49.9	999	6.7	3.3
115	52.2	1,044	7.0	3.5
120	54.5	1,090	7.3	3.6
125	56.8	1,135	7.6	3.8
130	59.0	1,180	7.9	3.9
135	61.3	1,226	8.2	4.1
140	63.6	1,271	8.5	4.2
145	65.8	1,317	8.8	4.4
150	68.1	1,362	9.1	4.5
155	70.4	1,407	9.4	4.7
160	72.6	1,453	9.7	4.8
165	74.9	1,498	10.0	5.0
170	77.2	1,544	10.3	5.1
175	79.5	1,589	10.6	5.3
180	81.7	1,634	10.9	5.4
185	84.0	1,680	11.2	5.6
190	86.3	1,725	11.5	5.8
195	88.5	1,771	11.8	5.9
200	90.8	1,816	12.1	6.1
205	93.1	1,861	12.4	6.2
210	95.3	1,907	12.7	6.4
215	97.6	1,952	13.0	6.5
220	99.9	1,998	13.3	6.7
225	102.2	2,043	13.6	6.8
230	104.4	2,088	13.9	7.0
235	106.7	2,134	14.2	7.1
240	109.0	2,179	14.5	7.3
245	111.2	2,225	14.8	7.4
250	113.5	2,270	15.1	7.6



## APPENDIX E: INSTRUCTIONS FOR THE ADMINISTRATION OF RABIES VACCINE AND RABIES IMMUNE GLOBULIN

Date: \_\_\_\_\_ (yyyy/mm/dd)

Dear Doctor/Nurse:

Re: \_\_\_\_\_, DOB \_\_\_\_/\_\_\_\_/\_\_\_\_ (yyyy/mm/dd)

The following outlines the protocol for rabies post-exposure prophylaxis (RPEP). RPEP consists of a series of rabies vaccine and one dose of rabies immune globulin. See the [BC Immunization Manual, Part 4 – Biological Products](#) for more information. **Please note that these products must remain refrigerated (between +2°C to +8°C) at all times and should only be handled and stored where this can be assured.** If this temperature has not been maintained, please contact the local health unit.

### **RABIES IMMUNE GLOBULIN (Rablg) - given if not previously immunized against rabies:**

A single dose of Rablg is given as soon as possible after exposure (day 0) for those who have not been previously immunized against rabies.

**Dose:** The dose of rabies immune globulin is calculated based on anatomic location of the wound, the weight in kilograms and the product used. The calculated maximum volume should not be exceeded because of possible interference with active antibody production.

For **IMOGAM or KamRAB**, the dose of Rablg (in mL) is calculated as: 
$$\frac{[20 \text{ IU/kg} \times \text{weight in kg}]}{150 \text{ IU/mL}}$$

For **HyperRAB**, the dose of Rablg (in mL) is calculated as: 
$$\frac{[20 \text{ IU/kg} \times \text{weight in kg}]}{300 \text{ IU/mL}}$$

We have calculated the maximum dose of (IMOGAM, KamRAB or HyperRAB) for this client to be \_\_\_\_\_ mL, using \_\_\_\_\_ kg as the weight. You have been shipped \_\_\_\_\_ vials of (IMOGAM, KamRAB or HyperRAB). Each vial contains \_\_\_\_\_ mL. **The client's weight should be confirmed prior to Rablg administration.**

**Site:** Prepare the amount of Rablg calculated above. Infiltrate as much Rablg as possible deep into and around the wound(s) in order to neutralize the virus. It may not be anatomically feasible to inject the maximum volume calculated above. Any remaining volume should be injected intramuscularly at a site distant from the vaccine. When more than one wound site exists, each should be locally infiltrated with a portion of the Rablg using a separate syringe and needle for each infiltration. If there are extensive wounds, where the calculated dose of Rablg (by weight) is **not** adequate in volume to infiltrate all wounds, the Rablg can be diluted using the appropriate diluent as described in [BC Immunization Manual, Part 4 – Biological Products](#), Immune Globulins, Rabies Immune Globulin (Rablg) to create an adequate volume to infiltrate all wounds. When there is no known wound site, the Rablg should be given into the exposed area. The deltoid should **not** be used for rabies immune globulin administration. Both deltoid sites should be reserved for the administration of rabies vaccine. ***Under no circumstances should rabies immune globulin be administered in the same syringe or at the same site as rabies vaccine.***

### **RABIES VACCINE:**

Give the first dose of rabies vaccine as soon as possible after exposure (**day 0**), and subsequent doses as per the intradermal (ID) or intramuscular (IM) regimen as specified in the [BC Immunization Manual, Part 4: Rabies Vaccine for POST-EXPOSURE Prophylaxis](#).

**Site:** See the BC Immunization Manual, [Appendix B: Administration of Biological Products](#) for the appropriate route and site according to the client's age.

### **TETANUS:**

Tetanus is also an important consideration and the opportunity to update tetanus-diphtheria immunization should not be missed. If you have questions, please contact your local health unit at: ( ) \_\_\_\_\_. Also, the Medical Health Officer is on call after hours at: ( ) \_\_\_\_\_.