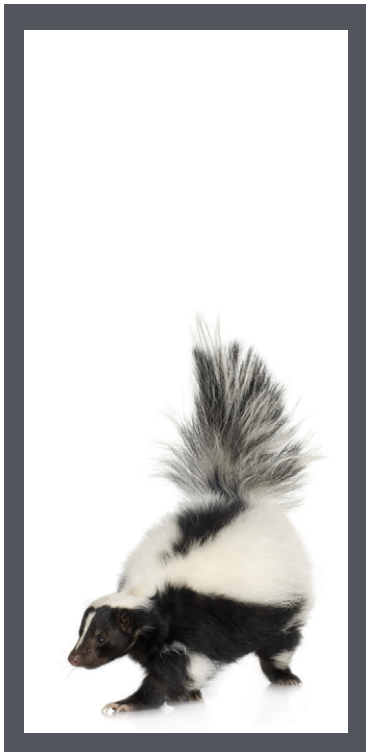
ANIMAL BITES & RABIES RISK

a guide for health professionals



DEPARTMENT OF HEALTH

Find this information electronically:

This entire booklet is available online at Rabies Information for Health Professionals (health.state.mn.us/diseases/rabies/risk). A fillable rabies submission form can also be found there.

For Consultation on Animal Bites and Rabies Risk in Humans

Minnesota Department of Health

Zoonotic Diseases Unit
625 North Robert Street
St. Paul, MN 55155
Telephone: 651-201-5414 or toll free: 1-877-676-5414

- 24/7 telephone consultation on potential rabies exposure is available to healthcare providers, veterinarians, public health professionals, and law enforcement.
- Rabies consultations are available to the public Monday through Friday, 8:00 a.m. to 4:30 p.m.

For Consultation on Rabies Exposure of Animals

Minnesota Board of Animal Health
Business hours (Monday - Friday, 8:00 a.m. to 4:30 p.m.)
625 North Robert Street
St. Paul, MN 55155
Telephone: 651-201-6808

For Specimen Submission for Rabies Testing

Minnesota Veterinary Diagnostic Laboratory
University of Minnesota-St. Paul Campus
Business hours (Monday - Friday, 8:00 a.m. to 4:30 p.m.)
1333 Gortner Avenue
St. Paul, MN 55108
Phone: 612-625-8787
or toll free: 1-800-605-8787

Table of Contents

I. INTRODUCTION **5**

II. MANAGEMENT OF ANIMAL BITES TO HUMANS **5**
Consultations on animal bites and rabies risk 5
Evaluation of the patient following an animal bite 5
Assessment of the need for rabies post-exposure prophylaxis 5
Table 1: Human Rabies Risk Evaluation: Species of the Biting Animal 6
Table 2: Guidelines for Managing Animal Bites and Bat Encounters in Humans 7
Figure 1: Evaluation of Potential Rabies Exposures Flowchart 8
Factors to consider when determining need for PEP 9
Type of exposure 9
Location and severity of the bite 9
Circumstances of the bite incident 9
Vaccination status of the biting animal 9
Species of the animal and requirements of the 10-day confinement and observation period 10
Rationale for a 10-day confinement and observation period 10

III. MANAGEMENT OF HUMAN-BAT ENCOUNTERS **10**
Bat encounters and bat bites 10
When should a bat be submitted for rabies testing? 10
How to capture a bat and submit it for testing 10
Assessment of the need for rabies PEP following a bat encounter 11

IV. RABIES POST-EXPOSURE PROPHYLAXIS (PEP) REGIMEN AND WOUND CARE **11**
Wound care 11
Rabies PEP overview 11
Human rabies immune globulin (HRIG) 12
Interference of HRIG with live virus vaccine administration 12
Rabies vaccine 12
Previously vaccinated persons 13
Deviations from recommended PEP vaccination schedule 13
Human rabies biologics 14
Human rabies immune globulin (HRIG) products 14
Human rabies vaccines 14
Adverse reactions 15

Table 3: Rabies Post-Exposure Prophylaxis for Healthy, Immunocompetent Persons, Including Pregnant Women....16
Table 4: Rabies Post-Exposure Prophylaxis for Immunocompromised Persons....17

V. RABIES PRE-EXPOSURE VACCINATION REGIMEN (PrEV)....18
Who should receive rabies pre-exposure vaccines?....18
Pre-exposure rabies vaccination series (PrEV)....18
Rapid Fluorescent Foci Inhibition Test (RFFIT)....18
Commercial laboratories offering RFFIT rabies antibody titer testing....18
Table 5: Rabies recommendations for pre-exposure vaccinated (PrEV) persons....19

VI. MANAGEMENT OF ANIMALS EXPOSED TO A RABID ANIMAL....20

VII. MINNESOTA'S RABIES RULES....20

VIII. RABIES TESTING....21
Guidelines for submitting suspect animals for rabies testing....21
Laboratory testing, result reporting, and positive result follow-up....21
Rabies testing in humans....21

IX. REFERENCES....22

X. MAP....23
University of Minnesota Veterinary Diagnostic Laboratory and Veterinary Medical Center, St. Paul Campus of the University of Minnesota....23

XI. FREQUENTLY ASKED QUESTIONS....24

XII. RABIES SPECIMEN SUBMISSION FORM....25

XIII. HOW TO CAPTURE A BAT HAND OUT....27

I. INTRODUCTION

Rabies is a fatal neurologic illness transmitted to people by direct contact with the saliva of a rabid animal, normally through a bite. However, transmission through saliva or cerebral spinal fluid (CSF) contact with mucous membranes or a fresh wound or scratch is possible. The virus cannot penetrate intact skin. Rabies virus is inactivated rapidly by ultraviolet light or desiccation and does not persist in the environment; therefore, contact with the environment around a rabid animal such as bedding, or water bowls does not present a risk.

In Minnesota, rabies is found mainly in skunks and bats. Livestock and pets generally develop the disease following a bite from a rabid skunk. People are generally exposed to rabies by bats, livestock,and unvaccinated pets. Bites from wild carnivores and large rodents such as muskrats, groundhogs, and beavers are also of concern (see Table 1 for species of concern). Species that are not a rabies risk in Minnesota include mice, hamsters, guinea pigs, gerbils, squirrels, chipmunks, rats, voles, and rabbits.

For more information and current statistics on rabies in Minnesota, visit www.health.state.mn.us/rabies.

II. MANAGEMENT OF ANIMAL BITES TO HUMANS

Consultations on animal bites and rabies risk

- For healthcare providers, veterinarians, public health professionals, and law enforcement: available 24/7 at 651-201-5414.
- For the public: available Monday-Friday, 8:00 a.m. to 4:30 p.m. at 651-201-5414.
- Please do not call the MDH Public Health Laboratory.
- For questions regarding animals that have been bitten by a suspect rabid animal in which there is no human exposure, please contact the Board of Animal Health (BAH) at 651-201-6808.

Evaluation of the patient following an animal bite

- Wash the wound well with soap and running water.
- Assess the need for tetanus vaccination booster.
- Assess the need for antibiotics.
- Assess the need for rabies post-exposure prophylaxis (PEP).

Assessment of the need for rabies post-exposure prophylaxis

- Is this a species that we are concerned about? (Table 1)
- Was there a bite or saliva exposure to a mucous membrane? (Table 2; Figure 1)
- Is the animal available for 10 days of observation or testing? (Table 2; Figure 1)

Table 1: Human Rabies Risk Evaluation: Species of the Biting Animal

Species of Concern		
Domestic Animals	Cat Dog Ferret Alpaca Cow Donkey	Goat Horse Llama Mule Pig Sheep
Wild Animals, Captive Wild or Hybrid Animals Please consult with MDH about bites from these wild animals. 24/7 consultation is available to health care providers and veterinarians at: 651-201-5414	Badger Bat Bear Beaver Bison Bobcat Coyote Deer Elk Ermine Fisher Fox Lynx Marten Mink	Monkey Moose Mountain lion Muskrat Opossum Otter Porcupine Puma/Cougar Raccoon Skunk Weasel Wolf Wolf/dog hybrid Wolverine Woodchuck
Bites From These Species are Not a Rabies Concern in Minnesota*		
All amphibians All birds All reptiles Chipmunk Gerbil	Gopher Guinea pig Hamster Hare Hedgehog Mole	Mouse Rabbit Rat Shrew Squirrel Vole

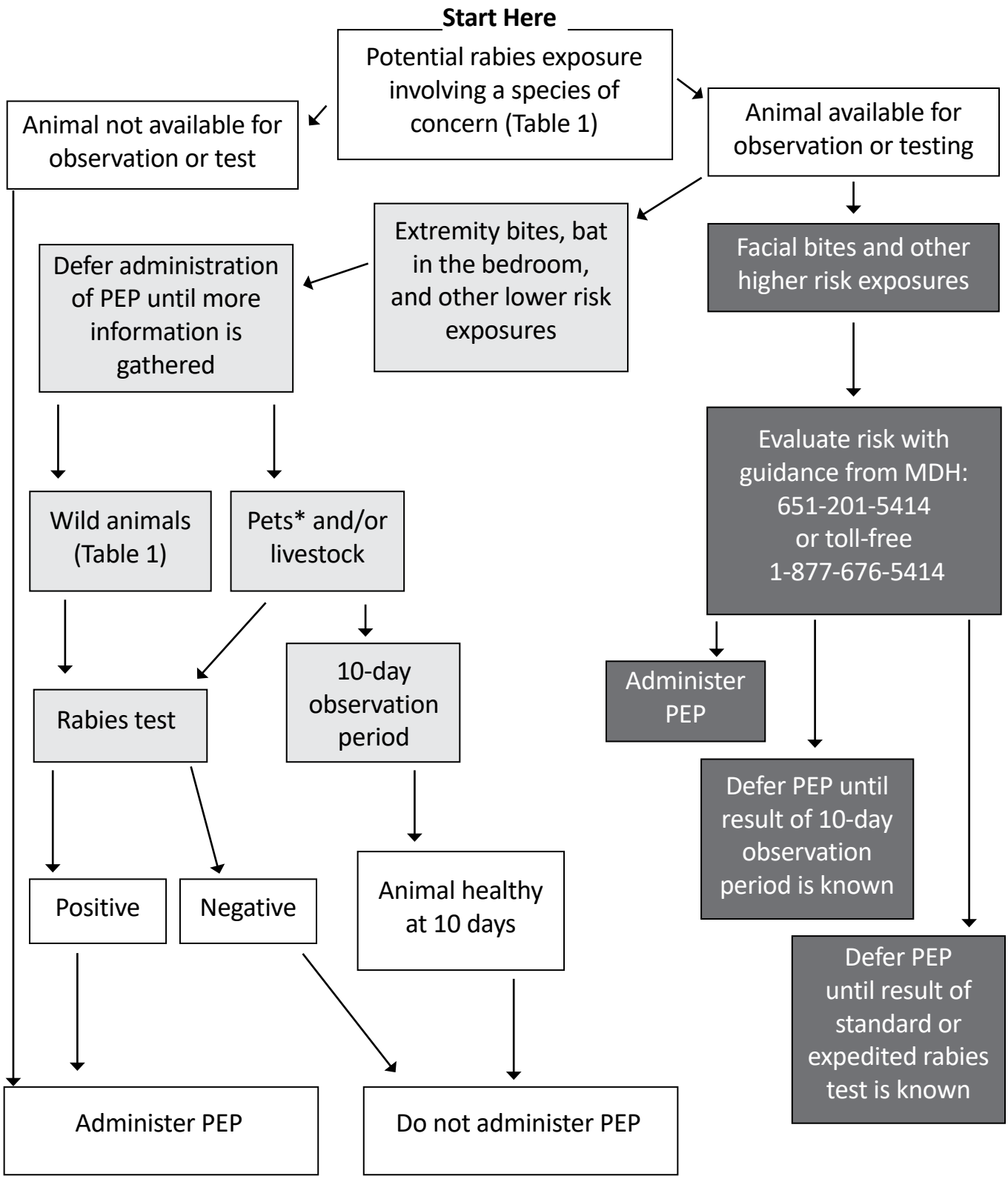
* MDH strongly discourages testing small rodents or rabbits for rabies, but unique situations do occur in which testing may be justified. Please do not submit these species without first consulting with MDH at 651-201-5414.

Table 2: Guidelines for Managing Animal Bites and Bat Encounters in Humans

Animal	Situation	Location of bite (or non-bite) exposure	Rabies post exposure prophylaxis (PEP) recommendations
Dogs, Cats, Ferrets	Animal available to be confined and observed for 10 days or tested for rabies	Extremities	Defer administration of PEP until outcome of 10-day observation period or rabies testing is known
		Face or head	Consult with MDH epidemiologists*
	Animal unavailable	Anywhere on body	Administer PEP regimen
Horses and other Livestock (ex. Cow, Sheep, Goat, Pig, Llama)	Animal available to be confined and observed for 10 days or tested for rabies	Extremities	Defer administration of PEP until outcome of 10-day observation period or rabies testing is known
		Face or head	Consult with MDH epidemiologists*
	Animal unavailable	Anywhere on the body	Administer PEP regimen
Bats, Skunks, Raccoons, Foxes, and other Wild Animals (see Table 1)	Wild animal available for euthanasia and testing	Anywhere on body	Consult with MDH epidemiologists*. Often, PEP can be deferred until rabies test results are known
	Wild animal unavailable	Anywhere on body	Administer PEP regimen

* **MDH epidemiologists are available 24/7 to healthcare providers and veterinarians at 651-201-5414 to discuss management of possible rabies exposure in humans.**

Figure 1: Evaluation of Potential Rabies Exposures Flowchart



*`Dogs, cats, ferrets

Factors to consider when determining need for PEP

Type of exposure

- **Bite exposures:** Consultation with a healthcare provider is recommended anytime a bite breaks the skin. Considerations include wound cleaning, tetanus vaccination, the need for antibiotics, and whether rabies post-exposure prophylaxis (PEP) is indicated.
- **Non-bite exposures:** Non-bite exposures include saliva contact to mucous membranes, saliva contact to fresh, non-scabbed skin wounds, and scratches. In general, the risk of rabies is very low following non-bite exposures; however, there are rare reports of rabies transmission by these routes suggesting that they constitute sufficient risk to consider administration of PEP on a case-by-case basis.

Location and severity of the bite

- When a bite is to an extremity, it is safe for the patient to wait for completion of a 10-day observation and confinement period of a domestic animal, or for rabies test results on the animal to determine whether PEP is necessary.
- Bites to the face and head are more urgent, and consultation with MDH on these cases is recommended (Table 2; Figure 1).
- Regardless of location, the deeper and more serious the bite wound(s), the greater the urgency for PEP.
- Normal laboratory turn-around time for rabies testing in Minnesota is 1 to 2 business days. In urgent situations, expedited rabies testing can be arranged by calling MDH at 651-201-5414.

Circumstances of the bite incident

- Factors surrounding the circumstances of the bite relevant to rabies risk include: the species of the animal; whether the bite occurred in an urban or rural setting; if there was a history of a skunk on the premises within the past few months; whether the pet has a previous history of aggressive behavior; if the pet runs loose/unmonitored when outdoors; and whether the bite was provoked or unprovoked.

Vaccination status of the biting animal

In the United States, rabies vaccine is licensed for dogs, cats, ferrets, sheep, cattle, and horses. An animal is currently vaccinated and can be considered immunized if the primary vaccination was given at least 28 days before the biting incident, or if the animal has received a primary vaccine and a booster vaccination within the time frame recommended by the manufacturer.

- Typically, dogs and cats are vaccinated for rabies as puppies or kittens, and the vaccination is boosted at one year of age. After that, dogs are generally vaccinated for rabies every 3 years, and cats are generally vaccinated annually or every 3 years, depending on the brand of rabies vaccine used.
- Even though rabies rarely occurs among currently vaccinated animals, out of an abundance of caution, all dogs, cats and ferrets are confined and observed for 10 days, or euthanized and tested for rabies following a bite to a human.
    - This is the law in Minnesota and it applies regardless of the animal's vaccination status. Local animal control and law enforcement officials are responsible for enforcement of this law.

Species of the animal and requirements of the 10-day confinement and observation period

Dogs, cats, ferrets, and livestock such as horses, cattle, goats and sheep should be confined and observed for 10 days following a bite, to rule out rabies risk.

- There is no such option for non-domestic species or wild animals that bite humans; these bites are handled on a case-by-case basis following consultation with MDH (Table 2; Figure 1).
- Following a bite, a dog, cat, or ferret that is currently vaccinated for rabies may be confined in the home or as directed by local authorities.
- A dog, cat, or ferret that is not currently vaccinated for rabies may be required by local authorities to be confined at a veterinary clinic or other secure location at the owner's expense.
- Any illness in an animal under confinement must be reported to MDH. If, during the 10-day confinement period, an animal shows signs suggestive of rabies, dies naturally or is euthanized, it must be tested for rabies.

Rationale for a 10-day confinement and observation period

- Animals cannot transmit the rabies virus to humans until the virus is present in the animal's salivary glands and saliva.
- Once the disease has progressed to this stage in domestic animals, they will begin to show obvious clinical signs of rabies.
- The time period between the onset of viral shedding and the onset of clinical signs of rabies is known to be a maximum of 3 to 4 days in dogs, cats, and ferrets.
    - Thus, if a dog, cat, or ferret had rabies virus in its saliva at the time of a bite (and could have transmitted the disease to the victim), it will be sick or dead within 3 to 4 days.
- The 10-day confinement period includes a safety factor.

III. MANAGEMENT OF HUMAN-BAT ENCOUNTERS

Bat encounters and bat bites

Most people who have been bitten by a bat report a stinging or needle prick sensation. However, bat bites may not be noticed, especially if someone is asleep, and bat bites may leave little or no evidence of a wound or puncture. Therefore, if there is any chance that there was physical contact with a bat, the bat should be tested for rabies. If the bat is not available for testing, then rabies post-exposure prophylaxis (PEP) should be administered.

When should a bat be submitted for rabies testing?

- A person has been bitten or has had any physical contact with a bat.
- A person wakes up to find a bat in the room where they were sleeping.
- A bat is found in a room with an unattended young child that cannot reliably report what happened.
- A bat is found in a room with anyone who cannot reliably communicate whether there was physical contact.

How to capture a bat and submit it for testing

(See How to Properly Catch a Bat for Rabies Testing on page 27 or www.health.state.mn.us/rabies/)

- Use a container with a lid. Do not use pillowcases, blankets or towels, as bats may bite through fabric.
- Wear heavy-duty or thick leather gloves. Bats can bite through gardening, latex gloves, or dish gloves.
- Wait for the bat to land. Approach the bat slowly and place the container over the bat. Then slide the lid (or a piece of cardboard) underneath the bat and flip the container over, trapping the bat inside.
- Secure the lid with tape. Create small breathing holes in the lid using scissors.

- Whenever possible, do not smash a bat with an object. The brain must remain intact for the bat to be tested for rabies, and it is easy to crush a bat's skull.
- There is no need to kill the bat; the bat may be hand delivered alive to the Minnesota Veterinary Diagnostic Laboratory during normal business hours for testing or it may be euthanized by a veterinarian prior to submission.
- If the bat is dead, keep it cool in a refrigerator, but avoid freezing. If the bat has been inadvertently frozen, it is still worthwhile to submit it as many will still be testable.
- Whenever possible, deliver the bat in person to the Veterinary Diagnostic Laboratory, keeping it cool during transport. Hand delivery reduces the time to testing, which can be important for maintaining sample quality, especially during summer months.
- If hand delivery is not possible, you may contact a local veterinary clinic to euthanize the bat (if necessary), package it, and arrange for next-day delivery to the Veterinary Diagnostic Laboratory. Next-day delivery is not an option on weekends as the Veterinary Diagnostic Laboratory is closed.
- In some Minnesota communities, an animal control officer or pest-control professional may be called to capture a bat and submit it for rabies testing.
- For more information on rabies specimen submission see Rabies Testing on page 21.

Veterinary Diagnostic Laboratory
University of Minnesota
1333 Gortner Ave
St. Paul, MN 55108
Phone: 612-625-8787, 1-800-605-8787

Assessment of the need for rabies PEP following a bat encounter

- Administration of rabies PEP should generally be deferred until the results of a rabies test are known. Test results are available within 1 to 2 business days
  - 3% to 4% of bats tested in Minnesota test positive for rabies every year.
- PEP should be initiated when there is a human/bat encounter during which physical contact occurred or may have occurred, and the bat is not available for testing.
- 24/7 telephone consultation on potential rabies exposure is available to healthcare providers, veterinarians, public health professionals, and law enforcement at: 651-201-5414. Rabies consultations are available to the public at the same number Monday – Friday, 8:00 a.m. to 4:30 p.m.

IV. RABIES POST-EXPOSURE PROPHYLAXIS (PEP) REGIMEN AND WOUND CARE

Wound Care

Wound cleansing is especially important in rabies prevention. In animal studies, thorough wound cleansing alone without other medical treatments (e.g., PEP) has been shown to markedly reduce the likelihood of rabies. Wounds should be promptly irrigated with water, or a povidone-iodine solution. In addition to decreasing the risk of rabies, it also decreases the risk for bacterial infection. Patients should receive a tetanus booster if their last vaccine was more than 5 years ago. The need for antibiotic prophylaxis should also be assessed.

Rabies PEP overview

The rabies PEP regimen involves administration of human rabies immune globulin (HRIG), which is given only once, and a series of four 1 mL rabies vaccinations (Table 3). HRIG and the first vaccination are given on the first day of treatment (designated Day 0) and three additional rabies vaccinations are given on Days 3, 7, and 14.

Immunocompromised persons receive a fifth vaccination on Day 28 and should be tested for seroconversion 7 to 14 days following completion of the PEP regimen (Table 4). For this regimen, pregnancy is not considered to be an immunocompromising condition.

Patients who have previously received either pre- or post-exposure rabies prophylaxis should receive only two rabies vaccine boosters following an exposure, given on Days 0 and 3 (Table 3; Table 4). Patients who have been previously vaccinated SHOULD NOT receive HRIG. Visit *Previously vaccinated persons* on page 13 for more information.

Human rabies immune globulin (HRIG)

Human rabies immune globulin (HRIG) is a biologic product prepared from human donors hyper-immunized with rabies vaccine. HRIG must be infiltrated into and around the bite wound site(s), and provides immediate, passive immune protection until the patient produces antibodies through the PEP vaccine series. HRIG has a half-life of approximately 21 days. It is administered only once, preferably on the first day of the PEP regimen (designated Day 0). Providers must be cautious about giving more than the recommended dosage of HRIG, as studies have shown that administering more than twice the recommended dose can reduce the immune response. If the HRIG was not administered on Day 0, it may be administered up to and including Day 7 of the PEP regimen. Beyond Day 7, HRIG is not indicated, as the patient's antibody response to the vaccine is presumed to have occurred.

- The recommended dosage of HRIG is 20 IU/kg body weight for all ages including children.
- Infiltrate as much of the HRIG as possible into and around the bite wound(s).
- Administer the remaining HRIG intramuscularly (IM) at a site distant from the first vaccination site, generally in the quadriceps or deltoids.
- If there is no wound, such as following a bat-in-the-bedroom exposure, then administer the entire dose of HRIG in the quadriceps or deltoids.

Interference of HRIG with live virus vaccine administration

HRIG can interfere with certain live virus vaccines. Therefore, the recommended interval between HRIG and measles- or varicella-containing vaccines is four months. Refer to table 3.6 in CDC's Timing and Spacing of Immunobiologics: Vaccines & Immunizations (www.cdc.gov/vaccines/hcp/imz-best-practices/timing-spacing-immunobiologics.html)- Table 3.6.

Rabies vaccine

A 1 mL dose of rabies vaccine is given IM in the deltoid area of adults or the anterolateral thigh of young children on Days 0, 3, 7, and 14 of the rabies PEP regimen (Table 3). The first vaccination is given concurrently with the HRIG at an anatomical site distant from the HRIG. When HRIG and the vaccine are given in the same anatomical site, antibody-vaccine complexes neutralize both products, leaving the patient without protection from infection.

An additional fifth dose of rabies vaccine is given on Day 28 to immunocompromised patients (Table 4). Rabies vaccine must NOT be given in the gluteal muscles due to the possibility of poor absorption from that site and lower neutralizing antibody titers.

Two inactivated, cell culture rabies vaccines are currently available in the United States: human diploid cell vaccine (HDCV) or purified chick embryo cell vaccine (PCEC). Both are considered equally safe and efficacious. It is recommended that a vaccine series be initiated and completed with the same vaccine

product; however, decreased efficacy or increased frequency of adverse reactions have not been documented when the series is initiated with one vaccine product and completed with another. The rabies vaccine series induces an active immune response that requires 7 to 10 days to develop and persists for many years. A rabies vaccine information statement (VIS) is available from CDC Rabies VIS (www.cdc.gov/vaccines/hcp/vis/vis-statements/rabies.html).

Previously vaccinated persons

Previously vaccinated individuals are those who have completed a pre-exposure or post-exposure regimen of human diploid cell vaccine (HDCV) or purified chick embryo cell vaccine (PCEC), or who have received a different vaccine outside of the U.S. and have a documented serum titer corresponding to complete neutralization at >1:5 serum dilution (or its equivalent, approximately 0.1-0.2 IU/mL) by the rapid fluorescent focus inhibition test (RFFIT). Following an exposure, previously vaccinated persons are given two 1 mL doses of vaccine intramuscularly in the deltoid area on Days 0 and 3. No HRIG is administered because it might inhibit the strength or speed of the expected anamnestic response.

If the patient's previous pre- or post-exposure vaccination regimen was administered prior to 1985 then the person is considered unvaccinated due to a change in vaccine biologics. Vaccines prior to 1985 were derived from animal nerve tissues and vaccines after 1985 are derived from human diploid cells or chick embryos. Administer the full rabies PEP regimen including HRIG.

Deviations from recommended PEP vaccination schedule

Once the decision to initiate rabies PEP has been made, the PEP regimen should be started as soon as possible. Every effort should be made to adhere to the recommended PEP regimen schedule. However, given that the PEP regimen requires multiple visits, deviations from the recommended schedule occur frequently. Minor delays in the PEP schedule do not affect the efficacy of the vaccinations. Longer delays of weeks or months are not well studied and could lead to a reduced immune response that could be fatal to a patient exposed to the rabies virus. Restarting the series is reserved for situations when the vaccine has been delayed significantly. For most minor delays or interruptions, the vaccination schedule can be shifted and resumed as though the patient were on schedule. For example, if a patient misses the dose scheduled for Day 7 and presents for vaccination on Day 10, the Day 7 dose should be administered that day, and the final dose given one week later on Day 17. Please consult MDH epidemiologists for advice when substantial deviations from the recommended schedule have occurred.

Note: Doses should not be administered prior to their scheduled date. For more guidance on how to approach rabies PEP deviations, please see "Rabies experts on demand: A cross-sectional study describing the use of a rabies telehealth service." Public Health Chall. 2023 Aug 1;2(3):10.1002/puh2.109 PMID: 38192571 National Library of Medicine (https://pubmed.ncbi.nlm.nih.gov/38192571/)

Human rabies biologics

Rabies products are commercially available through pharmaceutical distributors or may be obtained directly from the manufacturers using the toll-free numbers listed below. The Minnesota Department of Health does not provide rabies biologics. Check with your pharmacy to determine availability.

Human rabies immune globulin (HRIG products)

KEDRAB™ Kedrion Biopharma
Concentration 150 IU/ml
www.kedrab.com
1-855-353-7466

HyperRab™*
Grifols Therapeutics Bayer Biological Products
Concentration 300 IU/ml
www.hyperrab.com
1-888-474-3657

Human rabies vaccines

Human Diploid Cell Vaccine (HDCV) Imovax IM® (pre- and post-exposure) Sanofi Pasteur
www.vaccineshoppe.com
1-800-822-2463

Purified Chick Embryo Cell Vaccine (PCEC) RabAvert® (pre- and post-exposure)
Bavarian Nordic
www.rabavert.com
1-844-4BAVARIAN

*Note: HyperRab has a different concentration compared to the other immunoglobulin product and requires a lower volume to administer the recommended dose of 20 IU/kg. Care should be taken to ensure the correct dose of immunoglobulin is administered to ensure an adequate immune response.

Patient assistance programs

Patient assistance programs may be available from individual biologics manufacturers. Please refer to the websites listed in the above section for current programs.

Adverse reactions

In general, there is a very low frequency of serious adverse reactions to the rabies PEP regimen. Local pain, headache and low-grade fever may follow administration of HRIG. Pain, erythema, swelling, itching, and other mild local reactions are reported among 11-90% of vaccines. Rabies PEP should not be interrupted or discontinued because of local or mild systemic adverse reactions to rabies vaccine. Non-steroidal anti-inflammatory drugs and antipyretic agents, such as ibuprofen or acetaminophen, may be used to control mild adverse reactions.

An immune-complex-like reaction (generalized urticaria, sometimes accompanied by arthralgia, arthritis, angioedema, nausea, vomiting, fever, and malaise) occurs in approximately 6% of pre-exposure vaccinated individuals receiving a booster dose of rabies vaccine after primary vaccination. Although it is rare, this reaction can occur in persons receiving their primary vaccination regimen. No deaths resulting from these reactions have been reported.

When a person with a history of serious hypersensitivity to rabies vaccine must be revaccinated, antihistamines may be administered concomitant with vaccine, and the patient should be observed for development of anaphylaxis immediately following vaccination. The Zoonotic Diseases Unit is available at 651-201-5414 for consultation about the management of possible rabies exposure and PEP in patients with a history of serious adverse reactions to rabies vaccine.

For more information regarding the safety of rabies biologics, please consult Manning, SE., et al., Human rabies prevention--United States, 2008: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep, 2008. 57(RR-3): p.9-10. https://pubmed.ncbi.nlm.nih.gov/18496505/

Table 3: Rabies Post-Exposure Prophylaxis for Healthy, Immunocompetent Persons, Including Pregnant Women

Vaccination Status	Treatment	Dosage/Administration Guidelines for All Ages	Day of Regimen
Not Previously Vaccinated	• Wound cleansing • Tetanus toxoid booster* • Human rabies immune globulin (HRIG)	• 20 IU/kg body weight • Infiltrate HRIG into and around the wound • Remaining HRIG given IM at a site distant from the vaccination site • Never administer in the gluteal muscles	**Day 0** (HRIG can be given up to day 7)

	• Rabies vaccine	• **Four** 1 mL doses, given IM
		  • Adults/older children: deltoid area
		  • Young children: anterolateral thigh
		  • Never administer in the gluteal muscles
			Days 0, 3, 7, 14

Previously Vaccinated	• Wound cleansing
	• Tetanus toxoid booster*
	• Rabies vaccine
		• **DO NOT give HRIG**
		• **Two** 1 mL doses, given IM
		  • Adults/older children: deltoid area
		  • Young children: anterolateral thigh
		  • Never administer in the gluteal muscles
			Days 0, 3

* Indicated if last tetanus vaccine was more than 5 years prior to exposure

† Completed pre- or post-exposure regimen of human diploid cell vaccine (HDCV) or purified chick embryo cell vaccine (PCEC) after 1985, or received another vaccine with documented serum titer >0.5 IU/mL by the rapid fluorescent focus inhibition test (RFFIT).

Table 4: Rabies Post-Exposure Prophylaxis for Immunocompromised Persons

Vaccination Status	Treatment	Dosage/Administration Guidelines for All Ages	Day of Regimen
Immunocompromised, Unvaccinated Persons	• Wound cleansing • Tetanus toxoid booster* • Human rabies immune globulin (HRIG)	• 20 IU/kg body weight • Infiltrate HRIG into and around wound • Remaining HRIG given IM at a site distant from the vaccination site (never administer in the gluteal muscles)	**Day 0** (can be given up to day 7)
	• Rabies vaccine	**Five** 1 mL doses, given IM • Adults/older children: deltoid area • Young children: anterolateral thigh • Never administer in the gluteal muscles	**Days 0, 3, 7, 14, 28**
	• Post vaccination serologic testing	• Submit serum (2cc) for rabies antibody titer by RFFIT‡ • Adequate antibody titer: complete neutralization at ≥1:5 dilution by the RFFIT method	**7-14 days following PEP completion**

Immunocompromised, Previously Vaccinated Persons†	• Wound cleansing
	• Tetanus toxoid booster*
	• Rabies vaccine
		• **DO NOT give HRIG**
		• **Two** 1 mL doses, given IM
		  • Adults/older children: deltoid area
		  • Young children: anterolateral thigh
		  • Never in gluteal muscles
			Days 0, 3

	• Post vaccination serologic testing	• Submit serum (2cc) for rabies antibody titer by RFFIT‡ • Adequate antibody titer: complete neutralization at ≥1:5 dilution by the RFFIT method	**7-14 days following PEP completion**

* Indicated if last tetanus vaccine was more than 5 years prior to exposure

† Completed pre- or post-exposure regimen of human diploid cell vaccine (HDCV) or purified chick embryo cell vaccine (PCEC) after 1985, or received another vaccine with documented serum titer >0.5 IU/mL by the rapid fluorescent focus inhibition test (RFFIT).

‡ Refer to Commercial laboratories offering RFFIT rabies antibody titer testing on page 18

V. RABIES PRE-EXPOSURE VACCINATION REGIMEN (PrEV)

Pre-exposure vaccination against rabies simplifies the rabies post-exposure treatment, and it may protect in cases of unrecognized rabies exposure or when post-exposure treatment is delayed. It does not eliminate the need for appropriate treatment following a known rabies virus exposure.

Who should receive rabies pre-exposure vaccines?

In 2022, the ACIP published a modified pre-exposure prophylaxis vaccination schedule(https://www.cdc.gov/mmwr/volumes/71/wr/mm7118a2.htm). Individuals are placed into one of five risk categories when determining their need for PrEV. Category 1 is the highest risk and 5 is the lowest and the categories were based on recognized versus unrecognized exposures. Serial titer checks are unnecessary for people who will have recognized exposures because an exposure will prompt an evaluation for PEP. Risk categories may change for a person over their lifetime.

A 2-dose PrEV schedule has replaced the 3-dose PrEV schedule. The primary vaccination series is now two doses on Days 0 and 7 and then depending on the person's risk category they may require nothing additional, or they may require a 1-time booster, a 1-time titer check, or serial titer checks. (Table 5, page 19)

Pre-exposure rabies vaccination series (PrEV)

- Two 1 mL doses of rabies vaccine are given IM, one injection per day, on days 0, 7, in the deltoid area of adults or in the anterolateral thigh of young children.
- Human diploid cell vaccine (HDVC) or purified chick embryo cell vaccine (PCEC) may be used, although it is recommended that the vaccine series be initiated and completed with the same vaccine product.
- No HRIG should be given.
- Five risk categories determine the need for a one-time booster or periodic titer checks.

Rapid Fluorescent Foci Inhibition Test (RFFIT)

- The RFFIT[7] is the only recommended test for determining virus neutralizing antibody levels against the rabies virus. Other available titer tests (including the ELISA test) are not recommended for this purpose.
  - The ACIP[1] recommends that a single booster rabies vaccination be given when the titer falls below <0.5 IU/mL by the rapid fluorescent focus inhibition test (RFFIT), a virus neutralization test.

Commercial laboratories offering RFFIT rabies antibody titer testing

Both require 2 mL serum

Rabies Laboratory
Kansas State University
1800 Denison Ave
Manhattan, KS 66506
785-532-5650
www.ksvdl.org/rabies-laboratory

Atlanta Health Associates
309 Pirkle Rd, Suite D-300
Cumming, GA 30040
1-800-717-5612
www.atlantahealth.net

RFFIT testing may be available to order through clinical reference laboratories. Please review your lab's test catalog.

Table 5: Rabies recommendations for pre-exposure vaccinated (PrEV) persons

Risk Category	Typical Population	Primary PrEP Series	Long-term immunogenicity	Post-exposure rabies prophylaxis for pre-exposure vaccinated persons
1	People who work with live virus, perform rabies tests, or open the cranial cavity for necropsies	1 mL IM rabies vaccine given on Days 0 and 7	Check titers every 6 months; booster if titer <0.5 IU/mL	Following a rabies exposure, two 1 mL rabies vaccinations are given on Days 0 and 3. No human rabies immune globulin (HRIG) is given
2	People who handle bats, or have contact with bats and their environments, perform necropsies that don't involve opening the cranial cavity	1 mL IM rabies vaccine given on Days 0 and 7	Check titers every 2 years; booster if titer <0.5 IU/mL	
3	Veterinary staff, animal control officers, wildlife biologists and wildlife rehabbers, select international travels, risk will persist >3 years	1 mL IM rabies vaccine given on Days 0 and 7	Booster dose > Day 21 and no later than year 3 after 2-dose primary vaccination **OR** One-time titer check during years 1-3 after 2-dose primary vaccination; booster if titer is <0.5 IU/mL	
4	Same as for risk category 3, but risk duration <3 years	1 mL IM rabies vaccine given on Days 0 and 7	None	
5	Typical person living in the U.S.	None	None	Full vaccine Series

* The typical populations described may not include the characteristics of all people that fall within a described risk group. For more detailed information about these recommendations, please refer to the published MMWR.

VI. MANAGEMENT OF ANIMALS EXPOSED TO A RABID ANIMAL

Rabies is a reportable disease in Minnesota. Anyone who has reason to believe that an animal is infected with rabies or has been exposed to rabies should call the Minnesota Board of Animal Health (BAH) at 651-201-6808. BAH investigates all cases in which a domestic animal has been exposed to rabies under BAH Rules 1721.0570.

A wild animal that has potentially exposed a domestic animal to rabies should be tested whenever possible. Local animal control officers in some communities may assist with capturing a wild animal for rabies testing. Veterinarians can be contacted to assist with rabies specimen submission.

- For questions about rabies in animals or to report suspect or exposed animals, contact the Minnesota Board of Animal Health at 651-201-6808.
- More information on rabies in animals is available on the Minnesota Board of Animal Health website (mn.gov/bah/rabies).

VII. MINNESOTA'S RABIES RULES

RABIES PREVENTION AND CONTROL

1721.0570 RABIES POSTEXPOSURE MANAGEMENT PROCEDURES FOR ANIMALS.

Subpart 1. **Management of animals exposed to a rabid animal.**

A. An animal that is determined by the board to have been exposed to rabies must be managed as described in items B to D.

B. An animal that is currently vaccinated for rabies must be kept under confinement and observed for signs of rabies for 45 days and, unless exempted by the board, revaccinated for rabies within three days of the exposure.

C. An animal for which there is a licensed rabies vaccine, but which has never been vaccinated for rabies, must be euthanized or quarantined for 180 days.

D. All other animals must be evaluated on a case-by-case basis. The board may require the exposed animal to be euthanized, quarantined, or confined for up to 180 days. The board may also require the animal to be vaccinated for rabies.

Subp. 2. **Quarantine procedures.** Animals must be quarantined in a manner approved by the board so as to minimize contact with persons or other animals. Dogs, cats, and ferrets, unless exempted by the board, must be vaccinated or revaccinated for rabies at the beginning of the quarantine period.

Subp. 3. **Release of quarantine on rabies-exposed animals.** All animals that are quarantined for rabies must be inspected by a veterinarian at the end of the quarantine period. Quarantine established on an animal under this part must not be released until a written report is received by the board from a licensed veterinarian stating the veterinarian inspected the animal at the end of the quarantine period and observed no signs of rabies. No dog, cat, or ferret may be released from quarantine unless it is currently

vaccinated for rabies.

Subp. 4. **Reporting.** Any illness in an animal that is under confinement or quarantine established under this part must be reported immediately to the board.

1721.0580 MANAGEMENT OF ANIMALS THAT BITE HUMANS.

Subpart 1. **Dogs, cats, and ferrets.** A dog, cat, or ferret that bites a human must be kept under confinement and observed for signs suggestive of rabies for ten days, or the animal must be euthanized and tested for rabies. If requested by the Department of Health, a stray or impounded dog, cat, or ferret that bites a human may be euthanized and tested for rabies before the required five-day holding period as specified in part 1721.0520, subpart 10, or in Minnesota Statutes, section 346.47.

Subp. 2. **Other animals.** An animal other than a dog, cat, or ferret that bites a human must be managed on a case-by-case basis based on the recommendations of the Department of Health. The animals may be required to be confined and observed for signs suggestive of rabies. If the Department of Health requests a rabies test, the animal must be euthanized and tested for rabies.

Subp. 3. **Confinement procedures.** An animal under confinement for rabies observation must be restricted in such a way that the animal can always be found and cannot wander away. A dog, cat, or ferret that is currently vaccinated for rabies may be confined in the home or as directed by local authorities. A dog, cat, or ferret that is not currently vaccinated for rabies may be required by local authorities to be confined at a veterinary clinic or other secure location at the owner's expense.

Subp. 4. **Reporting and testing.** Any illness in an animal that is under confinement and observation for rabies established under this part must be reported to the Department of Health. If the animal shows signs suggestive of rabies, it must be euthanized and tested for rabies. An animal that dies or is euthanized during the confinement period must be tested for rabies.

Subp. **5. Enforcement.** Local animal control and law enforcement officials are responsible for enforcement of this part.

See the complete administrative rules for more details. (https://www.revisor.mn.gov/rules/1721.0570/)

VIII. RABIES TESTING

Guidelines for submitting suspect animals for rabies testing

The only test for rabies in animals that may be used to guide human rabies risk analysis is the direct fluorescent antibody (DFA) test. There is no live animal test for rabies. The animal's brain, specifically a complete cross-section of the cerebellum, hippocampus, and brainstem are required to perform the DFA test. The brain must be relatively fresh and in good condition, as the test cannot be done reliably if the different regions of the brain are not discernable. See the Rabies Specimen Submission Form on page 25 for complete instructions on specimen handling and submission.

Laboratory testing, result reporting, and positive result follow-up

- There is a $22.00 fee per animal and a $10.00 fee per accession payable to the University of Minnesota Veterinary Diagnostic Laboratory (VDL) for rabies testing by the DFA test. Multiple animals submitted from a related situation (bats from one location, litter of kittens, etc.) will be charged one accession fee. Out-of-state submissions cost $34.20. An additional fee of $25 will be charged for after-hours drop-off of specimens.
- Results for specimens received at the VDL before 11:00 a.m. will be available the next business day by 2 p.m. Results for specimens received after 11:00 a.m. will be available in two business days.
- Expedited testing is available in emergency situations. Healthcare providers, veterinarians, public health or law enforcement may contact Minnesota Department of Health (MDH) Zoonotic Diseases Unit at 651-201-5414 to discuss the need for an expedited test.
- Positive test results are reported to the BAH and the MDH.
- Positive rabies reports are telephoned immediately to the veterinarian, healthcare provider, or other submitter listed on the Rabies Specimen Submission Form.
- Situations involving laboratory-confirmed rabies positive animals are investigated, evaluated, and managed by MDH epidemiologists and BAH veterinarians.
- Negative rabies reports are emailed or mailed to the submitter within 1 business day of completion of the test.

Rabies testing in humans

- Testing for diagnosis of rabies in humans is performed at the Centers for Disease Control and Prevention (CDC). Please telephone the MDH Zoonotic Diseases Unit at 651-201-5414 for assistance with human rabies specimen submission and testing.
- Do not submit specimens for Rapid Fluorescent Foci Inhibition Test (RFFIT) or other antibody testing available at commercial reference laboratories. This test is only used to assess vaccine efficacy for persons who have received the rabies PrEV or PEP regimen.

IX. REFERENCES

1. Manning, S.E., et al., Human rabies prevention--United States, 2008: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep, 2008. 57(RR-3): p. 1-28.

2. Rupprecht, C.E., et al., Use of a reduced (4-dose) vaccine schedule for postexposure prophylaxis to prevent human rabies: recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep, 2010. 59(RR-2): p.1-9.

3. Compendium of animal rabies prevention and control, 2016:National Association of State Public Health Veterinarians. JAVMA, 2016. 248(5); p. 505-517.

4. Rabies. In: Heymann D, ed. Control of Communicable Diseases Manual 20th Edition. Washington DC: American Public Health Association, 2015; 497-508.

5. Rupprecht, C.E. and R.V. Gibbons, Clinical practice. Prophylaxis against rabies. N Engl J Med, 2004. 351(25): p. 2626-2635.

6. Minnesota Board of Animal Health Rules: 1721.0540-1721.0580.

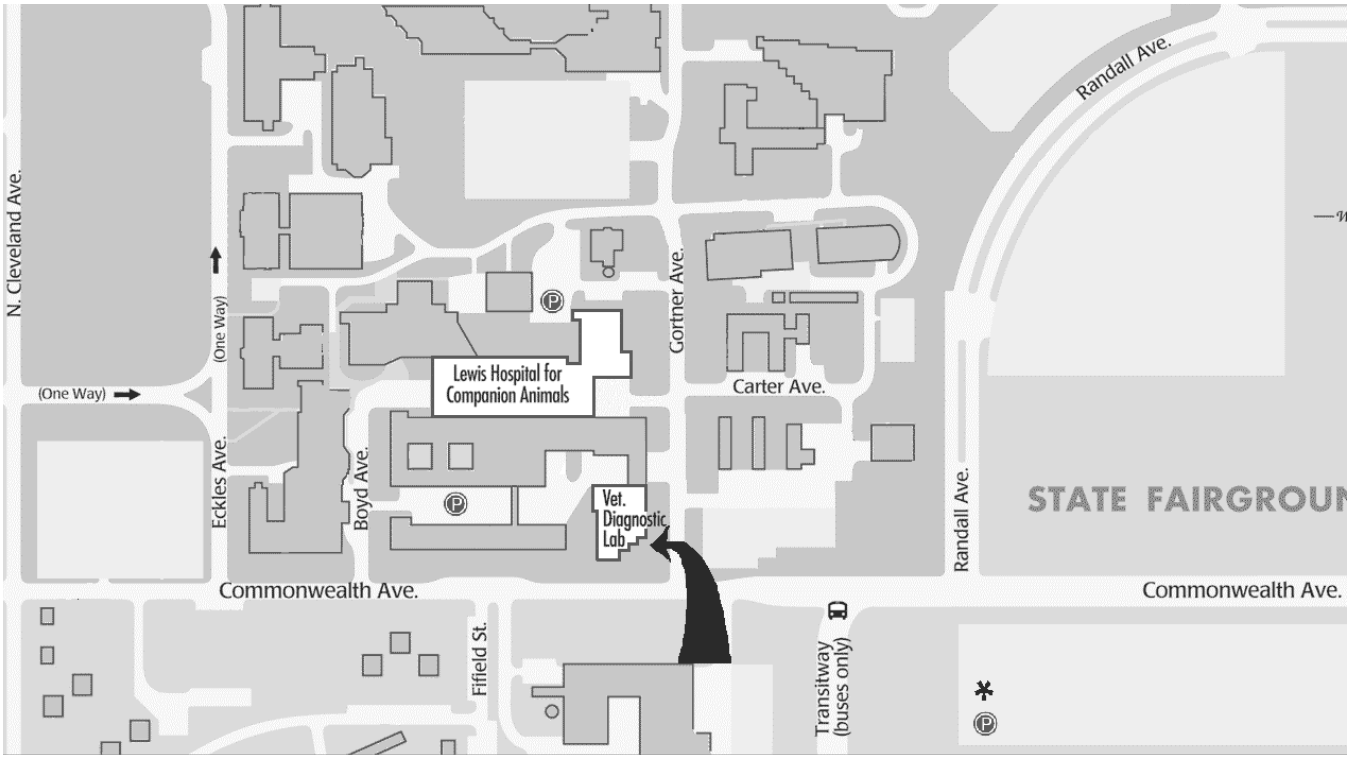
7. College of Veterinary Medicine, Kansas State University. RFFIT-Result interpretation-human. Accessed 10/26/2017. College of Veterinary Medicine, Kansas State University (www.ksvdl.org/rabies-laboratory).

8. Baker SE, Ross YB, Ellison JA, et al. Rabies experts on demand: A cross-sectional study describing the use of a rabies telehealth service. Public Health Chall. 2023; 2:e109. https://doi.org/10.1002/puh2.109.

9. Rao AK, Briggs D, Moore SM, et al. Use of a Modified Preexposure Prophylaxis Vaccination Schedule to Prevent Human Rabies: Recommendations of the Advisory Committee on Immunization Practices — United States, 2022. MMWR Morb Mortal Wkly Rep 2022;71:619–627. DOI: http://dx.doi.org/10.15585/mmwr.mm7118a2.

X. MAP

Figure 2. University of Minnesota Veterinary Diagnostic Laboratory, St. Paul Campus of the University of Minnesota



Additional information about the VDL can be found at
[Veterinary Diagnostic Laboratory (http://www.vdl.umn.edu)](http://www.vdl.umn.edu)

XI. FREQUENTLY ASKED QUESTIONS

1. My patient found a bat in her son's bedroom yesterday morning. She opened the window, and the bat flew out. She doesn't think the bat bit her son. Who, if anyone, would require rabies PEP in this situation?

   Only the son requires rabies PEP because he was asleep in a room with a bat that cannot be tested, and we can't know for certain whether the bat bit him while he was asleep. The mother does not need PEP because she wasn't exposed to the bat while asleep and had no physical contact with the bat.

2. My patient started rabies PEP and is scheduled for her 3rd rabies vaccination (Day 7) tomorrow. She is currently out of town – is it OK to give the Day 7 vaccination 2 or 3 days late? If so, when should her fourth (Day 14) vaccination be given?

   Minor deviations from the recommended vaccine schedule will not affect the strength of the immune response. Give the third vaccination as close to the recommended time as possible, then shift the schedule and resume as though the patient were on schedule, giving the fourth vaccination 7 days later.

3. What are the signs of rabies in cats (or dogs)? My patient is confining a cat that bit her for a 10-day period following the bite. What signs should she be looking for?

   An animal that had rabies virus in its saliva at the time of biting someone would develop severe illness or die within 3 to 4 days of the bite. (The 10-day observation period includes a safety factor.) Signs to watch for include loss of appetite, depression, lameness, fever, and neurologic signs such as behavior changes, vocalization, circling, or seizures. If the cat develops any of these signs, the patient should contact her veterinarian immediately. If the cat is alive and well 10 days following the bite, then there was no risk of rabies at the time of the bite.

4. I have a patient who was bitten by a dog in Mexico two weeks ago. He had a rabies vaccine there and was told that he was protected. Should I restart the entire PEP series?

   In situations like this it is best to get as much information as possible about vaccinations given outside the U.S. and then call MDH for a consultation. This would include the name of the vaccine, the type of facility administering the vaccine, and the likelihood that vaccine cold-chain had been preserved. Several factors go into determining whether a vaccine given outside of the U.S. can be trusted to produce an adequate immune response.

5. A patient who was bitten by a bat a few months ago is wondering if it is too late to receive rabies PEP.

   There is no time limit regarding the administration of PEP after an exposure as long as the patient hasn't developed clinical signs of rabies. In this case it is still appropriate to initiate PEP. Administration of both human rabies immune globulin (HRIG) and four doses of rabies vaccine is recommended regardless of the time elapsed since the exposure.

6. How long does the rabies virus last in the environment?

   Rabies virus does not persist in the environment; it is inactivated quickly by UV light and desiccation. Rabies is transmitted only through a bite from a rabid animal or saliva or CSF fluid from a rabid animal contacting a person's mucous membrane. Rabies is not transmitted through environmental contact or through aerosols.

MINNESOTA

VETERINARY DIAGNOSTIC LABORATORY
UNIVERSITY OF MINNESOTA
Driven to Discover℠

MDH Use Only

Rabies Specimen Submission Form

Physicians and veterinarians may obtain information on rabies 24/7 from the Minnesota Department of Health at 651-201-5414. Public calls are taken at the same number Monday through Friday, 8 a.m. to 4:30 p.m.

VDL Use Only

Rabies Form

Submitter

Date: ___/___/___

Name of submitter: _____

Vet clinic/Org. name: _____

Address: _____

City: _____ Zip: _____ County: _____

Phone: _____ Email: _____

Payment required at drop off. $33 in state, $35.30 out of state. Additional $50 for after hours.

Responsible for payment: ☐ Veterinary clinic ☐ Submitter ☐ Owner

Test Animal

☐ Owned ☐ Stray ☐ Wild

Species: _____ If bat: ☐ Alive ☐ Dead

Animal name or ID: _____

Date of death: ___/___/___ Tested animal: ☐ Euthanized ☐ Killed ☐ Found dead

Owner (if different from submitter): _____ Phone: _____

Address of test animal: _____ City: _____ Zip: _____ County: _____

Explain situation:

Other potential disease rule-outs: _____

☐ H5N1 testing. More information: High Path (H5N1) Influenza Testing in Pets (vdl.umn.edu/resources/disease-resources/avian-influenza/high-path-h5n1-influenza-testing-pets)

Necropsy: ☐ Yes ☐ No Note, necropsy requires additional charges and forms: Necropsy/Tissue - General Exam (vdl.umn.edu/tests-fees/)

Cremation: ☐ Mass (no remains returned) ☐ Individual (ashes returned) Arranged by owner/vet clinic, refer to cremation services on back.

Exposure

☐ No human exposure ☐ Human exposure Date of exposure: ___/___/___

Type of exposure: ☐ Bite, where on body: _____ ☐ Non-bite

Person(s) exposed: _____ Age(s): _____

Where did exposure occur? _____ County: _____

Phone: _____ Alternate phone: _____

Laboratory only

☐ Whole body ☐ Head ☐ Brain

☐ Alive ☐ Dead

Condition: ☐ Good ☐ Fair ☐ Autolyzed ☐ Traumatized ☐ Dried ☐ No tissue

☐ Hippocampus
☐ Insufficient
☐ Cerebellum
☐ Insufficient
☐ Brain stem
☐ Insufficient

Comments:

Date sent to MDH: ___/___/___ Initials: _____

Cost:

There is a fee of $23.00 per animal plus a $10.00 lab accession fee ($33 total). Out-of-state submissions have an additional 10% charge ($35.30 total). There is an additional $50 after hours fee if a sample is submitted on the weekend or between 4:30 p.m. and 7:45 a.m. on weekdays. Charges associated with euthanasia, specimen preparation, packaging, shipping and testing are the responsibility of the person requesting the rabies testing.

Species of animal to be tested:

Companion animals should be euthanized by a veterinarian. Live production animals should be delivered during VDL business hours (see below). Live bats will be accepted during normal business hours only; they should be hand delivered and labeled "Live Bat for Rabies Testing." Small rodents (hamsters, gerbils, guinea pigs, squirrels, chipmunks, rats, mice, gophers, etc.), insectivores (moles and shrews), and lagomorphs (hares and rabbits) do not pose a risk for rabies in Minnesota, and should not be submitted for testing. For guidance on unusual situations involving bites from these animals, please call 651-201-5414. Reptiles, amphibians, and birds are not susceptible to rabies and will not be tested for it.

Specimen preparation:

Complete, bilateral samples of brain stem, hippocampus, and cerebellum are required for rabies testing. If possible, submit the head of large animals and the entire body of small animals. When submitting only the brain, submit the entire brain. Submit fresh, chilled tissues only; do not fix the brain in chemical preservatives. Refrigerate, do not freeze specimens for rabies testing prior to shipping. However, if specimens have been inadvertently frozen, they may yield satisfactory results; do not thaw them prior to shipping. If a bat is captured in the middle of the night, keep the bat cool and call the VDL in the morning.

Packing requirements:

- Chill specimen prior to bagging and packing for hand delivery or shipping by overnight carrier. Specimens that have been bagged and packed for delivery while still warm may arrive in unsatisfactory condition for rabies testing due to autolysis.
- Once chilled, double bag and securely seal specimen in heavy, leak-proof plastic bags. Brain only specimens should be packaged in a hard plastic container to preserve the integrity of the specimen. Place in a leak-proof container, preferably a Styrofoam box with a cardboard exterior.
- Include leak-proof freezer packs in sufficient number to keep the specimen cold during transit. During the summer months particularly, many samples arrive at the VDL warm and in unsatisfactory condition for rabies testing.
- Fill any remaining space within the container with newspaper or other absorbent packing material to absorb fluids in case of leakage.
- Complete this form, place in a plastic bag and attach to the outside of the specimen container.
- Label the exterior of the box, "Veterinary Diagnostic Specimen."

Delivery instructions:

Whenever possible, specimens should be hand delivered. If hand delivery is not possible, ship by an overnight delivery service (such as FedEx). For next day results, specimens must be received at the VDL by 11 a.m. Specimens should never be sent by mail – even Priority mail. Questions about specimen submission should be directed to the VDL.

Specimens should be delivered to:

Business hours (M-F, 8:00-4:30)
Veterinary Diagnostic Laboratory (VDL)
University of Minnesota-St. Paul Campus
1333 Gortner Avenue
St. Paul, MN 55108
Phone: 612-625-8787
After 4:30 p.m. and weekend phone: 651-775-0417

Cremation services:

Animal remains will be processed using mass chemical cremation unless arrangements for individual cremation are made by the client or the client's veterinarian. Please indicate individual or mass cremation on the rabies specimen submission form by checking the box. Once the test result is known, an animal testing negative for rabies may be released to a private cremation service. An animal greater than 22 pounds that tests positive for rabies will not be released for cremation due to the risk of human exposure. If an animal is untestable for any reason, remains may be released for individual cremation on a case by case basis.

How to Properly Catch a Bat for Rabies Testing

Got bats?

Did you wake up to a bat?

Did anyone have contact with a bat?

Did you find a bat with an unattended child?*

*incapacitated adult, etc.

Time to catch 'em!

Gather your bat capture kit!

Container

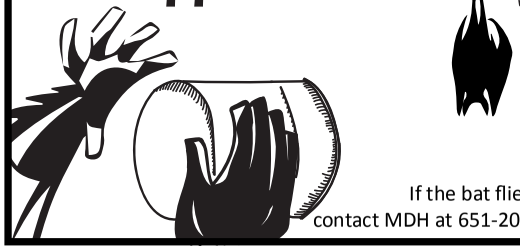
Lid

Tape

Be sure to wear leather gloves to prevent bites. Sheets or towels are too thin!

Gloves

Wait for the bat to land and approach it slowly.

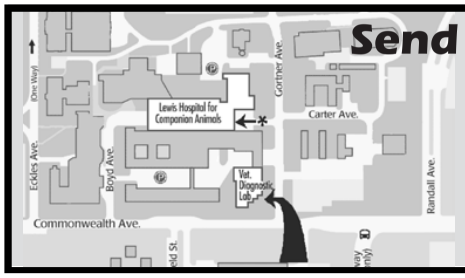


If the bat flies away contact MDH at 651-201-5414

Place the container over the bat.

Slide the lid underneath, flip it over, and secure the lid with tape!

Send that bat for testing!



Bats can be brought in alive

1. Deliver the bat in person to:
   Minnesota Veterinary Diagnostic Lab
   1333 Gortner Ave., St. Paul, MN 55108
   1-800-605-8787 | 612-625-8787
2. Contact a local veterinary clinic to arrange shipment

DEPARTMENT OF HEALTH

Questions? Call: 651-201-5414 or 1-877-676-5414
www.health.state.mn.us

Minnesota Department of Health
Infectious Disease Epidemiology, Prevention, and Control Division
Zoonotic Diseases Unit
651-201-5414
www.health.state.mn.us

Minnesota Board of Animal Health
651-201-6808
www.bah.state.mn.us

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