

HUMAN AND ANIMAL RABIES

I. DESCRIPTION AND EPIDEMIOLOGY

A. Overview

Rabies is an infection of the central nervous system (CNS) by a virus in the family Rhabdoviridae. Rabies virus causes an acute encephalitis that is nearly always fatal. Variants of the rabies virus are adapted to being maintained in certain mammalian species, including wild and domestic canids, numerous bat species, skunks, and raccoons. All mammals are susceptible to infection with any rabies virus.

B. Human and Animal Rabies in California

Human rabies is infrequent in California; in the last 50 years (1972-2023), 19 cases of rabies were identified in California residents, the last case reported in 2012. Approximately half of these infections were acquired domestically and half outside the U.S.

Approximately 200 rabid animals are identified each year in California. The majority (80+%) of these are various species of bats. Skunks and foxes are also commonly identified as rabid. Rabies occasionally spills over from wild animals to domestic animals, including dogs and cats.

C. Transmission

Rabies virus infects nervous tissues, particularly concentrated in the brain and spinal cord. At the time--or shortly before--the infected animal or person develops signs of neural dysfunction, rabies virus migrates from the CNS into the salivary glands. The virus replicates in the salivary glands and is shed in saliva. Transmission to a susceptible host occurs when virus-laden saliva is deposited in subdermal tissues, typically through a bite wound. Rabies virus replicates locally for a variable period before migrating retrograde through peripheral motor neurons to the CNS.

Transmission of rabies virus via urine, blood, sweat, milk, or other secretions and excretions from a rabid animal is not known to occur. Rabies has been rarely transmitted through transplant of organs and tissues from a donor who was not known to have rabies at the time of death.

D. Human Rabies

i. Incubation Period

The incubation period varies from a few days to several months but is typically 30-90 days. Incubations of more than one year are rarely reported. Incubation depends on the dosage of virus deposited at the inoculation site and the distance from the inoculation site to the CNS.

ii. Symptoms and Clinical Signs

Clinical presentations of rabies in humans are diverse in manifestations and duration. A prodrome of headaches, myalgias, and other non-specific symptoms frequently precedes onset of neurologic dysfunction by 3-5 days. Paresthesia at the inoculation site is commonly reported. Rabies rapidly progresses to encephalitic signs including agitation and confusion. Abnormalities of cranial nerves, and somatic sensory and motor deficits, may also be noted. Classic rabies hydrophobia, hypersalivation, and aerophobia develop late, chiefly in patients with dog variant rabies virus, whereas tremor and myoclonus are more common in patients infected with bat variant rabies virus. Coma and death from autonomic failure occur within 1 to 3 weeks of symptom onset.

iii. Diagnosis

See Sections [II-A Case Definitions](#) and [III-D Case Investigation, Surveillance, and Reporting](#).

iv. Clinical Management

Post-exposure prophylaxis (PEP) is highly effective at preventing progression to clinical rabies when administered in a timely fashion and according to established [recommendations](#) following a rabies exposure. But once clinical signs appear there is no treatment protocol that has proven effective for rabies; management of rabies patients is chiefly palliative. Reports of patients surviving confirmed rabies infection are exceedingly rare and the case-fatality approaches 100%.

E. Animal Rabies

i. Incubation Period

The incubation period for natural infection with rabies virus is unknown in most animal species but likely varies both within and across species. Incubation ranged from 14 to 177 days in experimentally inoculated Mexican free-tailed bats (*Tadarida brasiliensis*), whereas domestic dogs developed clinical signs 9 to 42 days following experimental inoculation.

ii. Symptoms and Clinical Signs

Clinical signs of rabies are myriad and vary by species. Principal neurologic manifestations of rabies in domestic animals have been classically categorized as “furious” or “dumb/paralytic”. The furious form of rabies is characterized by excitability, increased aggression, hyperesthesia, and other encephalitic signs. Motor deficits, obtundation, mandibular and laryngeal paralysis—leading to dysphagia and hypersalivation—characterize the paralytic form. Death occurs 2-4 days following onset of neurologic signs. Wild animals frequently display atypical behavior, such as nocturnal animals active in the daytime, or normally shy and reclusive animals being approachable. Rabies in bats usually results in motor and navigational deficits, rendering them immobile.

iii. Diagnosis

See Section [II-B Case Definitions](#).

iv. Clinical Management

There is no treatment protocol for rabies. Any animal suspected of having rabies should be isolated and humanely euthanized.

II. CASE DEFINITIONS

A. Human Rabies

Note: The surveillance case definition for [Human Rabies](#) was approved by the Council of State and Territorial Epidemiologists (CSTE) in 2011.

i. Clinical Description

Rabies is an acute encephalomyelitis that almost always progresses to coma or death within 10 days after the first symptom.

ii. Laboratory Criteria

Confirmatory laboratory evidence:

- a. Detection of Lyssavirus antigens in a clinical specimen (preferably the brain or the nerves surrounding hair follicles in the nape of the neck) by direct fluorescent antibody test, **OR**
- b. Isolation (in cell culture or in a laboratory animal) of a Lyssavirus from saliva or central nervous system tissue, **OR**
- c. Identification of Lyssavirus specific antibody (i.e., by indirect fluorescent antibody (IFA) test or complete rabies virus neutralization at 1:5 dilution) in the cerebrospinal fluid (CSF), **OR**
- d. Identification of Lyssavirus specific antibody (i.e., by indirect fluorescent antibody (IFA) test or complete rabies virus neutralization at 1:5 dilution) in the serum of an unvaccinated person, **OR**
- e. Detection of Lyssavirus viral RNA (using reverse transcriptase-polymerase chain reaction [RT-PCR]) in saliva, CSF, or tissue.

iii. Case Classification

Confirmed

A clinically compatible case that is laboratory confirmed by testing at a state or federal public health laboratory.

iv. **Comments**

Laboratory confirmation by all of the above methods is strongly recommended.

B. Animal Rabies

Note: The surveillance case definition for [Animal Rabies](#) was approved by the Council of State and Territorial Epidemiologists (CSTE) in 2022.

i. **Laboratory Criteria**

Confirmatory laboratory evidence:

- a. A positive rabies virus direct fluorescent antibody test; **OR**
- b. A positive rabies virus direct rapid immunohistochemical test (dRIT); **OR**
- c. A positive rabies virus test by immunohistochemistry (IHC) on formalin-fixed tissue; **OR**
- d. A positive pan-lyssavirus probe-based real time reverse transcription-polymerase chain reaction RT-PCR test; **OR**
- e. Detection of lyssavirus nucleic acid by genomic sequencing; **OR**
- f. Isolation of rabies virus (in cell culture or in a laboratory animal).

**While central nervous system (CNS) tissue is most commonly tested and is the preferred tissue type for identifying a rabies virus or non-rabies lyssavirus infection, identification of rabies virus or a non-rabies lyssavirus in any tissue or body fluid is evidence of infection.*

Note: The categorical labels used here to stratify laboratory evidence are intended to support the standardization of case classifications for public health surveillance. The categorical labels should not be used to interpret the utility or validity of any laboratory test methodology.

ii. **Case Classification**

Confirmed

Meets confirmatory laboratory evidence.

III. CASE SURVEILLANCE, INVESTIGATION, AND REPORTING

A. Purpose of Reporting and Surveillance

Human Rabies and Animal Rabies are reportable conditions under California Code of Regulations (17 CCR §2500, 2505). Confirmed cases should be reported and investigated:

- To identify sources of infection
- To assess contacts for possible exposure and to counsel them on the need for PEP
- To educate people about how to reduce their risk of exposure

B. Local Health Jurisdiction General Investigation Guidelines

i. Confirmed human rabies

a) Exposure history

- 1) The local health department (LHD) should attempt to identify any travel history and animal contact the case-patient experienced during the six months prior to symptom onset. Because rabies patients are usually deceased, comatose, or otherwise noncommunicative at the time that rabies is confirmed, a portrait of the case-patient's activities will likely require compiling information provided by family, friends, coworkers, and other associates.
- 2) If a strongly suspicious exposure episode is identified (e.g., bat bite), the LHD should gather information on other persons who were present and might have been concurrently exposed. Other persons present should be interviewed and assessed for possible rabies exposure and advised on PEP.

b) Contact tracing

- 1) The LHD should identify persons—family, friends, coworkers, medical care staff—who had contact with the case-patient during and up to two weeks prior to onset of the patient's clinical illness.
- 2) Possible contacts should be interviewed and assessed for contact with the patient's saliva (e.g., kissing, sharing drink containers or eating utensils, placing an ET tube). Rabies PEP should be recommended to persons who had contact with the patient's saliva or for whom contact with the patient's saliva cannot be ruled out.

ii. Confirmed animal rabies

a) Wild animals

- 1) Determine the circumstances in which the animal was collected, including location, date and time, animal's condition, and disposition.

- 2) If the animal was alive at the time of collection or initial report, identify persons who had contact with the animal (e.g., the public, veterinary staff, wildlife rehabilitation staff) and inquire whether any bites or other possible contact with the animal's saliva occurred. Rabies PEP should be recommended to persons who had contact with the animal's saliva or for whom contact with the animal's saliva cannot be ruled out.
- 3) Advise local animal control officials of any pets or other domestic animals that had known or suspected contact with the rabid animal.

b) Domestic animals

- 1) Identify persons who had contact with the animal (e.g., owners, caretakers, veterinary staff) and inquire whether any bites or other contact with the animal's saliva occurred. Rabies PEP should be recommended to persons who had contact with the animal's saliva or for whom contact with the animal's saliva cannot be ruled out.
- 2) Advise local animal control officials of any pets or other domestic animals that had known or suspected contact with the rabid animal.
- 3) If the animal was presented for veterinary care prior to its death, collect information on the animal's clinical presentation and course. Obtain copies of all rabies vaccination documentation, if any.
- 4) Interview the animal's owners regarding the animal's history, including any time spent outside its county of residence in the year preceding onset of rabies. Notify CDPH Veterinary Public Health Section (VPHS) immediately (phone 916-552-9740; e-mail vetph@cdph.ca.gov) if the animal was outside the U.S. at any time during the 12 months preceding onset of rabies.

c) Management of contact animals

- 1) Domestic animals that have contact with a confirmed rabid animal should be managed in accordance with state regulations (17 CCR §2606(c)) and the [California Compendium of Rabies Prevention and Control](#).
- 2) Domestic animal contacts that are currently vaccinated against rabies should receive one booster dose of rabies vaccine as soon as possible and placed in confinement for 30 days.
- 3) Domestic animal contacts that are not currently vaccinated against rabies should be euthanized. At the local health officer's discretion, unvaccinated domestic animal contacts may alternatively be placed into strict confinement for 180 days.

C. State and National Case Reporting

Cases of rabies in humans and animals must be reported to CDPH. A CalREDIE record should be created to report cases of human rabies. Cases of animal rabies should not be reported through CalREDIE. Local health jurisdictions may use the Animal Rabies

Case Report form in CalREDIE for internal documentation, but essential information must be entered onto the Animal Rabies Case Report form and the completed form sent by e-mail (vetph@cdph.ca.gov) or fax (916-552-9725) to CDPH-VPHS.

CDPH reports provisional counts of confirmed rabies cases to the U.S. Centers for Disease Control and Prevention's (CDC) Nationally Notifiable Disease Surveillance System weekly and provisional extended data to CDC's Pox and Rabies Branch monthly. Final counts of confirmed rabies cases are reported to NNDSS and CDC's Pox and Rabies Branch following the conclusion of the surveillance year.

D. Viral and Rickettsial Diseases Laboratory (VRDL) and Other Laboratory Resources

Ante-mortem diagnosis of rabies in humans is challenging and often requires multiple specimens collected over the course of the patient's illness and tested by different methods. Ante-mortem testing of suspected human rabies patients is available through [CDPH-VRDL](#). Healthcare providers who wish to submit specimens to CDPH-VRDL for rabies testing must coordinate through their local health department. Testing of specimens sent without prior consultation with, and approval by, CDPH rabies subject matter experts or the VRDL medical officer will be delayed or denied.

Post-mortem testing of animals for rabies is available through select county public health laboratories and CDPH-VRDL. Because criteria for testing and preferred preparation of specimens differ across laboratories, the laboratory should be consulted prior to preparing and shipping specimens for testing.

IV. MANAGEMENT AND CONTROL MEASURES

Human Rabies

A. Management of Human Cases

See Sections [I-D-iv Description and Epidemiology](#) and [III-B-i Case Surveillance, Investigation, and Reporting](#).

B. Management of Contacts

See Section [III-B-i-b Case Surveillance, Investigation, and Reporting](#).

Animal Rabies

A. Management of Animal Cases

See Sections [I-E-iv Description and Epidemiology](#) and [III-B-ii Case Surveillance, Investigation, and Reporting](#).

B. Management of Human Contacts

See Sections [III-B-ii-a](#), [III-B-ii-b Case Surveillance, Investigation, and Reporting](#).

C. Management of Animal Contacts

See Section [III-B-ii-c Case Surveillance, Investigation, and Reporting](#).

V. APPLICABLE STATE STATUTES AND REGULATIONS

California Health & Safety Code

- §121585: The Director of CDPH annually declares areas of the state where rabies constitutes a public health hazard.
- §121705, 121710: Concealing information about a biting animal or violation of a local health officer's rabies quarantine order is a misdemeanor.

California Code of Regulations, Title 17 (Public Health)

- §2500: Health care providers are required to immediately report a case or suspected case of human rabies to the Local Health Officer.
- §2502: The Local Health Officer is required to immediately report a case of human rabies to CDPH.
- §2505: Laboratories must report within one day detection of rabies virus to the Local Health Officer of the local health jurisdiction where the patient resides.
- §2606: Animal bites must be reported to the Local Health Officer and biting animals isolated or euthanized and tested for rabies. Animals exposed to a rabid animal must be quarantined.

California Code of Regulations, Title 3 (Food and Agriculture)

- §797: Cases of rabies in livestock are reportable within 24 hours to the California Department of Food and Agriculture's Animal Health Branch.

VI. ADDITIONAL RESOURCES

- [CDPH California Compendium of Rabies Prevention and Control](https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/CACompendiumofRabiesControlandPrevention.pdf)
(<https://www.cdph.ca.gov/Programs/CID/DCDC/CDPH%20Document%20Library/CACompendiumofRabiesControlandPrevention.pdf>)
- [CDPH Rabies webpage](https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Rabies.aspx)
(<https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/Rabies.aspx>)
- [U.S. Centers for Disease Control and Prevention, Rabies webpage](https://www.cdc.gov/rabies/)
(<https://www.cdc.gov/rabies/>)

- [National Association of State Public Health Veterinarians, *Compendium of Rabies Prevention and Control*](http://www.nasphv.org/documentsCompendiaRabies.html)
(<http://www.nasphv.org/documentsCompendiaRabies.html>)
- [Advisory Committee on Immunization Practices, Rabies vaccine recommendations](https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/rabies.html)
(<https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/rabies.html>)

VII. UPDATES

Original version finalized and completed on June 21, 2023.