Rabies is a disease that affects the brain and nerves. It is caused by a virus that can be transmitted among all mammals, including humans.

Rabies occurs in nearly every country worldwide. The World Health Organization (WHO) estimates that at least 55,000 people die of rabies every year, mostly in rural areas of Africa and Asia. Because rabies cases are often not recognized or reported in rural areas, the true number is probably higher.

- 40% of people who are bitten by animals who may have rabies are children under 15 years of age.
- Approximately 99% of human rabies cases are due to dog bites.
- Once a person or animal develops clinical signs of rabies, he or she will die. Rabies is always fatal once the disease develops.
- Rabies is fully preventable in animals and in humans by vaccination.

Who gets rabies?

- All mammals can get rabies.
- Birds, reptiles and fish do not get sick from the virus, and they do not spread the virus to mammals.

In various regions of the world, the species of animals who are most likely to get rabies and to transmit it to people may differ. These differences depend on a number of factors, including the abundance of certain species that commonly transmit rabies, what rabies control programs are in place, and the activities of humans that put them at risk for contracting rabies. For example, in North America, rabies usually affects wild animals like bats, skunks, raccoons and foxes. It is rare in dogs and cats because of strong vaccination programs. In Asia and Africa, it is most common in domestic dogs because of poor vaccination programs. In areas in which people hunt for bush meat, people are more likely to be exposed to rabies from wild animals.

The most common human victims of rabies are children who are bitten by rabid domestic dogs.

Children are the most common victims of dog bites, and hence most likely to be exposed to rabies from unvaccinated animals. Vaccinating dogs and teaching children how to handle animals safely and respectfully are the best ways to prevent these tragedies.
Rabies can be fully prevented by vaccination. This is true for animals as well as for people. People who are at high risk for coming in contact with a rabid animal should be vaccinated. This group may include veterinarians, wildlife rescuers, wildlife biologists, and people who live in areas where incidence of dog rabies is high. The schedule for vaccination is explained below.

Dogs and other mammalian pets, as well as cows, horses and other mammalian livestock, should be vaccinated against rabies in areas in which rabies is common in dogs or in local wildlife.

Once an animal or person develops clinical signs of rabies, the disease is always fatal. There is no treatment or cure once the person or animal shows signs of the disease.

**Vaccination of dogs is the most important and effective way to prevent rabies in people.**

### How people become infected with rabies

The term “exposure” is used often by the WHO and other organizations that disseminate information about rabies. The term means that a person or animal has been exposed to the virus. The virus is present in bodily fluids from an animal who has rabies, especially in the saliva. For example, if a person is bitten by a rabid dog, the teeth of the dog create a wound on the skin, and the saliva on the teeth injects the virus into the wound. This is a bite-wound exposure.

There are two types of exposure that may result in rabies infection:

1. Bite from a rabid animal
2. Non-bite exposure: contamination of an open wound, the eyes, or the inside of the nose or mouth with the saliva of a rabid animal.

The most common way in which an animal or person is infected with the rabies virus is via the bite of an infected animal.

The rabies virus is introduced into the muscle or skin via a wound, finds its way to nearby nerves, and then travels up the nerves to the brain. The virus replicates in the brain, then travels via nerves to the salivary glands. The virus is then excreted via the saliva. This is why the saliva and bite wounds are the most dangerous.

A rabid animal usually looks sick and behaves strangely. However, dogs, cats, ferrets and some wild animals may begin to shed virus in the saliva for several days before the animal begins to look sick or to behave strangely. This is the reason for the 10-day quarantine rule (described below).

Rodents and rabbits are not likely to carry rabies, and bites from these species do not usually require post-exposure treatment. For example, if a healthy, caged pet hamster bites someone on the finger, it is not usually necessary for the person to rush off for a rabies vaccination. However, each case must be evaluated professionally and individually to determine the risk and to take appropriate precautionary measures.

A person will not get rabies from simply touching an animal, stroking the fur or coming into contact with blood, faeces, urine or “spray” (as from a skunk).
2. Avoid being bitten

Learn how to behave respectfully with animals, and teach children how to do so. For example:

- Do not disturb female animals who are taking care of young
- Do not interfere with animals who are eating
- Leave sleeping animals alone.
- If an animal seems frightened, aggressive or shy, keep a respectful distance and do not force yourself on the animal.
- Do not approach wild animals. Wild animals prefer to avoid humans, but may attack if they are startled or feel threatened or feel that their young are in danger.
- If a wild animal is behaving abnormally, be especially sure to avoid contact

3. Pre-exposure vaccination (also called pre-exposure prophylaxis)

This means being vaccinated before there is the chance of being bitten or otherwise exposed to rabies.

People who work with mammals in areas in which rabies is endemic should be vaccinated (e.g., veterinarians, animal rescue workers, wildlife biologists). Ideally, people who live in areas where dog rabies is common should also be vaccinated. This is often not done, however, for socio-economic and other reasons.
4. Post-exposure prophylaxis

This involves a series of vaccinations that are given after a person has been bitten by an animal who is rabid or who may be rabid.

The World Health Organization (WHO) has detailed protocols for pre- and post-exposure management of human patients. These are considered the international standard. They are listed in detail at the bottom of this document.

If a person is bitten by a potentially rabid animal, s/he will require post-exposure prophylactic treatment, regardless of whether s/he had received pre-exposure vaccinations. However, if the person was previously vaccinated, then fewer injections will be needed, and treatment will be much less expensive. Previous vaccination also improves the chances of survival, particularly if the patient cannot get adequate medical help quickly.

In some areas, appropriate rabies vaccine and post-exposure treatment may be difficult to obtain. When travelling to such areas, particularly if rabies is endemic in the species with which one is likely to come into contact (e.g., dogs), pre-exposure vaccination is highly recommended.

Different countries may have different types of rabies vaccine, some made locally. It is important to be vaccinated with a WHO-approved vaccine (detailed below). Non-approved vaccines may not reliably protect a person, and may even be dangerous.

Employers and supervisors of staff who are at risk for rabies exposure through their work must be aware that laws in many countries do not allow employers to mandate vaccination of staff and volunteers: employers may only be able to recommend it. It is advised that all staff and volunteers be asked to sign a waiver of responsibility that holds the employer free from harm if the person fails to follow recommended pre- and post-exposure prophylactic procedures.

What is an antibody titer?

A vaccine stimulates the immune system in the body to produce antibodies against a particular organism – in this case, the rabies virus.

Antibodies are constantly on patrol in the body for the organism that they recognize. When they find one that they recognize, they attack it. In this way, antibodies against the rabies virus attack the virus that enters the body and kill it before it can replicate and make the patient sick.

The level of antibody in the blood against a specific organism is called an antibody titer. In this case, it would be called the rabies titer. We can measure antibody titers in the blood, and this tells us whether we are adequately protected or if we need a booster vaccination.

Modern human rabies vaccines induce an antibody titer that usually lasts for at least two years in most healthy people. But there can be a great deal of variation, so rabies titers should be checked and boosters given according to the WHO guidelines (detailed below).

After receiving a vaccine, it takes the body 1-2 weeks to produce a full antibody titer.
1. The “furious” form of rabies

... makes an animal aggressive and likely to bite or attack. This is the kind that is usually shown in pictures or cartoons of a rabid dog.

2. In the “dumb” form of rabies

... the animal may be disoriented, partially or fully paralyzed, may act as though normal daylight is uncomfortable, or may stand and stare with a “spaced out” look.
Clinical signs of rabies are acute: they begin suddenly and progress quickly, over the course of a few days. A slow, chronic condition that develops over weeks or months is not likely to be rabies.

The incubation period of a disease is the time that it takes from initial exposure to the pathogen (e.g., introduction of rabies virus via a bite wound) to the onset of clinical signs of disease. For example, if someone has a cold and sneezes on you, and then you come down with a cold 3 days later, the incubation period was 3 days. The incubation period for rabies in animals can be anywhere between a week and several months or even years. In dogs, the incubation period is usually between two weeks to three months. In people it is usually one to three months, but may be years. These incubation periods are the basis of the rationale for quarantine times, for example, for dogs or cats when they travel internationally, or if a dog has been bitten by an animal who may have rabies.

The incubation period for rabies may vary with species, the location of the exposure (e.g., on the foot vs. on the face) and the degree of exposure (e.g., a deep bite vs. a superficial scratch). In general, the farther away from the brain that the exposure occurred, the longer the time it takes for the virus to travel up the nerves to the brain, and the longer the incubation period. Children are often bitten on the face, which is close to the brain and hence can result in clinical disease more quickly.

**Other common signs of rabies in animals include:**

- drooling or “frothing” from the mouth
- difficulty swallowing
- difficulty breathing
- change in voice (e.g., when barking, mooing, whinnying)
- anxiety, nervousness, restlessness
- erratic behavior such as snapping unprovoked, sudden irritability, wandering restlessly, attacking an area of his or her own body
- dilated or unequally-sized pupils
- a strange, stiff or unsteady gait
- seizures
- Rabid horses may roll on the ground. This may cause people to mistake the problem for colic.

**Diagnosis of rabies**

The only way to determine with certainty whether an animal was rabid is to send the body of the animal to a special government laboratory that will examine the brain.

**There is no test with which to diagnose rabies in a living animal**

Most countries have government-mandated protocols for what to do with live animals who may be rabid (outlined below).

Diagnosis of rabies in humans is complicated and requires several tests to be done, some of them several times. Samples of blood, saliva, spinal fluid and skin biopsies must be tested for the presence of rabies virus or for the presence of antibodies. Remember that antibodies begin to appear only several days or weeks after exposure to the virus, and the virus may take weeks to reach the nerves, salivary glands and spinal fluid and neck skin.

**Diagnostic tests are therefore accurate only quite some time after the person has been infected. Treatment must begin long before a definitive diagnosis can be made.**
Pre-Exposure Prophylaxis for humans

People at risk of rabies exposure should be vaccinated. This may include:

- People who work with mammals (e.g., veterinarians, animal rescuers, animal control officers, or field biologists)
- People who live in areas with high endemic rabies (e.g., Asia and Africa)
- Laboratory workers who may come in contact with the virus in the laboratory

The first time that a person is vaccinated against rabies, s/he must receive a series of three vaccinations: on Day 0, Day 7 and Day 28.

Once vaccinated, a person’s antibody titer should be measured once per year to determine when a booster vaccination is necessary. The antibody titer should remain above 0.5 IU/ml.

If antibody titer measurement is not possible, a booster vaccination every two years is recommended.

Three types of human vaccines are approved for use by the WHO. It is important to be vaccinated with one of these three. Avoid unapproved vaccines.

1. Human diploid cell line (HDCV) Rabivac™
2. Purified Vero cell vaccine (PVRV) Verorab™, Imovax™, Rabies Vero™, TRC Verorab™
3. Purified chick embryo cell vaccine (PVECV) Rabipur™

This information is current at the time of writing, but readers are advised to check the WHO website for the most current information: http://www.who.int/rabies/en/

People who work with mammals in areas in which rabies is endemic should be vaccinated prophylactically.

Post-Exposure Prophylaxis:
What to do if a person is bitten by a potentially rabid animal

This is an emergency. Do not delay treatment.

First and immediately wash the wound for 15 minutes with soap and clean, running water. If available, use disinfectant soap or iodine. This is a critical step to wash out as much virus as possible from the wound.

Seek medical attention for post-exposure treatment immediately. The type of treatment that the patient receives will depend on:

- Whether the patient has already been vaccinated (pre-exposure prophylaxis)
- The type of exposure that occurred (WHO Categories 1-3):

**Category 1:** touching or feeding animals, licks on intact skin

**Category 2:** nibbling of uncovered skin, minor scratches or abrasions without bleeding

**Category 3:** single or multiple bites or scratches that break the skin, licks on broken skin, contamination of eyes or the inside of the mouth or the inside of the nose with saliva from the rabid animal, or exposure to bat bites or scratches.
Treatment may include:

- Rabies vaccine. This is necessary for all Category 2 and 3 exposures.
- Rabies Immunoglobulin (RIG) injection around the wound
  – Necessary for Category 3 exposures if the patient has not received pre-exposure vaccine. People who have received pre-exposure vaccination do not need RIG.
  – Injection of RIG should be done as soon as possible – preferably within 24 hours. It may be done up to 7 days after the exposure occurred.
- Antibiotics, if there is concern about the wound developing a bacterial infection.
- Treatment of the wound with dressings. Ideally, wounds should not be sutured closed.
- Tetanus vaccination, if the patient is not current on this vaccine. Tetanus boosters are recommended every 10 years for adults. Children should be vaccinated 5 times before the age of 6 years. See http://www.cdc.gov/vaccines/vpd-vac/tetanus/

Pregnant women and infants should receive post-exposure prophylaxis per standard protocol.


Try to identify the animal who bit the person. Remember: Safety First!

If the animal is dangerous and trying to attack, do not try to catch it yourself. Call the Animal Control Department and have a professional contain the animal.

Keep the animal confined in a cage or box and call the Animal Control Department or Public Health Service immediately. Make sure that children and pets do not get near the confined animal.

If it is a wild animal or an un-owned dog or cat, the animal may be euthanized and sent for testing. The person who was bitten should begin post-exposure treatment right away. Do not wait for the test results on the animal to begin treatment.

If the animal is owned, the vaccination record should be obtained from the animal’s owner. The local health department should be consulted on how to proceed. Laws may vary among regions, but the international standard recommends that:

- If the animal is unvaccinated and appears acutely ill, s/he should be euthanized and sent for testing. The person who was bitten should begin post-exposure treatment right away. Do not wait for the test results on the animal to begin treatment.
- If the animal appears healthy, s/he should be confined for 10 days for observation by a veterinarian. If signs of rabies develop in those 10 days, the animal must be euthanized and sent to a laboratory for testing.
  – The animal must not be vaccinated during the 10 days observation period. Vaccinating the animal may interfere with an accurate diagnosis of rabies if the animal does turn out to be rabid.
  – The person who was bitten does not need to begin post-exposure treatment unless the animal begins to show signs of rabies.

- If in doubt, call the local health department for advice.

Remember to report the bite incident to the local health department. Government health departments keep track of bite wounds and rabies exposure for national and international statistics on the disease. Data from these records drive research, policy, and aid for combating diseases such as rabies.
Rabies vaccination for animals

Vaccination of dogs is the most effective, safe and efficient way to prevent rabies in people and dogs. Rabies vaccination programs are the most important element to preventing human rabies cases. Remember that more than 99% of human rabies cases are caused by rabid dogs. Rabies is entirely preventable in dogs by vaccination.

Dogs, cats and other pets who have the opportunity to come into contact with other animals should be vaccinated against rabies per local laws. This usually involves vaccination once per year or once every three years, depending on the extent of endemic rabies in the area, and vaccine certification.

Puppies and kittens should be vaccinated the first time at or after 3 months of age.

It is very helpful for a vaccinated animals to wear a special collar or tag that shows that the animal has been vaccinated against rabies. This could protect the animal from being euthanized unnecessarily for testing if he or she bites someone. It would prevent a person who is bitten by the animal from having to get unnecessary rabies post-exposure injections. A vaccinated dog who roams free also reassures other community members. This is a critical issue in some areas where people are afraid of rabies. Identification of the dog as rabies-vaccinated may avoid strife in the community, or may prevent the dog from being killed by someone who is afraid of rabies.

Domestic livestock (mammals) may be vaccinated in areas where risk of exposure to rabid animals is high (e.g., from domestic dogs or wildlife such as bats).

(Above) Dogs who are vaccinated and who wear a special rabies collar can reduce the fear that communities sometimes feel about roaming dogs. Fear and misunderstanding about rabies bring a great deal of suffering to animals and people alike.

A Bali dog vaccinated by the Bali Animal Welfare Association receives a special red collar that signals, "I'm vaccinated!"
If the dog or cat is properly vaccinated against rabies and is bitten by a potentially rabid animal, the dog or cat must be re-vaccinated immediately and held under close observation for 45 days. If clinical signs of rabies develop during that time, the animal must be euthanized and tested for rabies.

If the dog or cat is not vaccinated, s/he should be either euthanized or held under quarantine for 6 months. If clinical signs of rabies develop during that time, the animal must be euthanized and tested for rabies. If no clinical signs develop, the animal is vaccinated one month before release from quarantine.

If the dog or cat was vaccinated several years ago and is not up-to-date on vaccines, the veterinarian will need to consider the case based on the facts of what happened, and advise the animal’s owner what to do.

Animal vaccines must be licensed for use in that species, and must be produced under reliable quality-control conditions. There are many available internationally. Your veterinarian should have a list of approved vaccines. Alternatively, you may find them on the United States Center for Disease Control web site at: http://www.cdc.gov/rabies/specific_groups/veterinarians/vaccines.html

Domestic animals and humans are vaccinated with an injectable vaccine. Wildlife are usually vaccinated by oral vaccines that are delivered in specially-designed bait distributed in wildlife areas.

What to do if a pet dog or cat is bitten by a potentially rabid animal

Take the animal to a veterinarian as soon as possible. If there will be a delay of more than an hour to get the animal to a veterinarian, put on rubber gloves and carefully wash the wound with soap and water for 15 minutes. If the animal is upset and tries to bite, stop. Always remember: Safety First.

International guidelines dictate the following protocols for dogs or cats exposed to rabies:

- In areas where there are a lot of stray or free-roaming dogs, special projects may be set up to vaccinate dogs with oral vaccine as well.

Vaccination programs that aim to control rabies in animals require that at least 70% of animals in the population are vaccinated annually. This creates a natural barrier that prevents the disease from spreading in the population. This 70% mark is the goal of dog vaccination programs to control canine rabies in endemic areas.

Community members queue their dogs for rabies vaccination in Cape Town, South Africa. Policy and resources to support education and vaccination empower communities to take care of their animals well.

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Information resources about rabies

- Centers for Disease Control and Prevention, U.S.A. government http://www.cdc.gov/rabies/
- Global Alliance for rabies control http://www.rabiescontrol.net/index.html

- Video on rabies control by the American Veterinary Association http://www.youtube.com/watch?v=VyPI28YRHlU
- World Rabies Day http://www.worldrabiesday.org/
- This video shows and explains the most common animals affected by rabies. http://www.youtube.com/watch?v=37HnP5cv3Y&feature=relmfu or http://monkeysee.com/play/18130-rabies-what-animals-are-most-likely-to-be-rabid

To control rabies where the disease is endemic in dogs, at least 70% of dogs must be vaccinated annually.