

Rabies

Extended Version

Classic case: Any animal with behavioral changes and multifocal neurological deficits

Presentation: Recent history of bite wound

Most North American transmission from wild animals

3 Basic forms (extremely variable)

1. Cerebral (furious)

- Aggression, hyperesthesia
- Vocalization
- Sialosis, tenesmus
- Seizures

2. Brainstem (dumb)

- Somnolence, stupor, dementia
- Ataxia, opisthotonus
- Facial hypalgesia
- Pharyngeal paralysis
- Excessive drooling

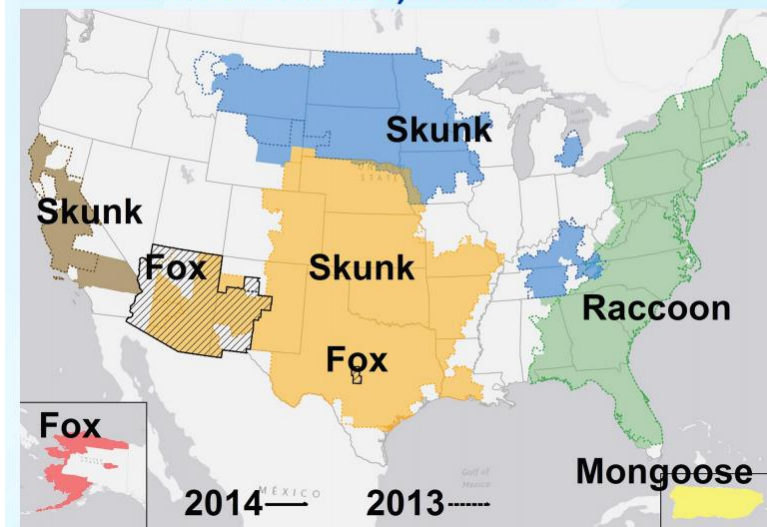
3. Spinal cord (paralytic)

- Progressive, ascending paralysis, monoparesis/plegia
- Truncal, limb, and perineal hyporeflexia and hypalgesia
- Priapism, urinary incontinence
- Self-mutilation



Rabid dogs cause 99% of human rabies deaths worldwide.
Image courtesy, CDC

Distribution of major rabies virus variants among mesocarnivores in the United States and Puerto Rico, 2008 to 2014.



Canada detects rabies too, primarily in raccoons, foxes, skunks and bats (~100 a year)

Map courtesy, US Centers for Disease Control & Prev (CDC)



The Usual Suspects

In North America, government-mandated vaccination of pet dogs and cats has limited circulation of rabies to wild reservoirs, primarily in **raccoons, bats, skunks and foxes**.

Images courtesy, Alan Vernon (raccoon) Dietmar Nill (bat), Alison Wardman (skunk), US Dept of Interior (fox)

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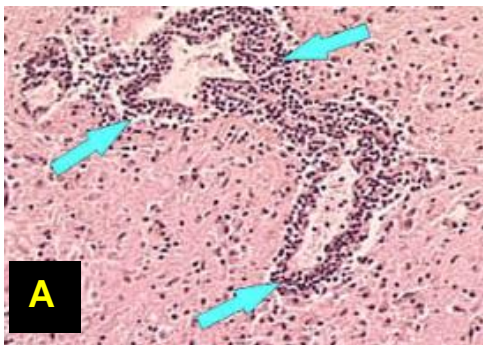
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DDX: The kitchen sink-anything causing behavioral changes & multifocal neuro deficits

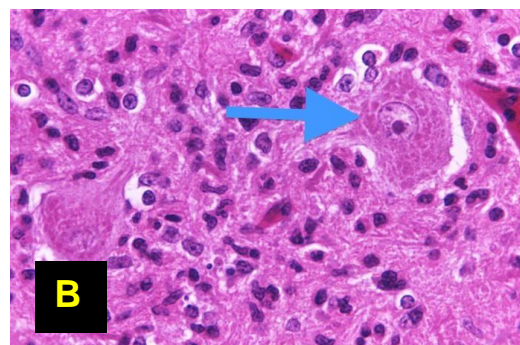
- **Horses**-EPM, EEE, WEE, VEE, EHV-1, WNV, abscess, neoplasm, hepatic encephalopathy, verminous migration, botulism, polyneuritis equi, cervical vertebral malformation, equine motor neuron disease, equine degenerative myeloencephalopathy, neoplasm
- **Cattle**-Disco-spondylitis, neoplasm, listeriosis, thrombotic meningoencephalitis, abscess, malignant catarrhal fever, verminous migration, lead poisoning, botulism
- **Dogs**-Distemper, GME, pseudorabies, WNV
- **Cats**-FIP, FIV, panleukopenia, feline Borna virus, pseudorabies
- **Sheep**-Listeriosis, scrapie, pseudorabies, abscess, Maedi-Visna, Louping Ill, ammonia toxicity, WNV, enzootic ataxia
- **Goats**-Scrapie, listeriosis, pseudorabies, CAE, ammonia toxicity, WNV, lead poisoning
- **Pigs**-Pseudorabies, water deprivation/salt toxicity, picornaviral encephalitis, hemagglutinating encephalomyelitis

Test(s) of choice:

- **Clinical diagnosis is difficult**, especially where rabies is uncommon
 - Early rabies easily confused with other diseases or normal aggression.
 - Clinical Dx alone should not be relied on when making public health decisions.
 - When rabies is suspected, definitive dx is required, by laboratory confirmation.
 - Requires euthanasia to obtain brain tissue for testing.
- **Direct and indirect immunofluorescent antibody (IFA) of brain tissue**
 - Must include **medulla oblongata (brain stem) and cerebellum**
 - Should be preserved by refrigeration with wet **ice or cold packs**
 - If IFA results indeterminate, can do mouse inoculation test or tissue culture
- Histopathology-**VARIABLE**, trained microscopists look for:
 - Mononuclear infiltration
 - Perivascular cuffing of lymphocytes or polymorphonuclear cells (PMNs)
 - Lymphocytic foci
 - Babes nodules consisting of glial cells
 - Negri bodies - intracytoplasmic inclusions (**NOT** pathognomonic for rabies)
- Immunohistochemistry – more sensitive than histopathology



A. Perivascular cuffing (3 arrows)=inflammation around a blood vessel.



B. Neuron with intracytoplasmic Negri bodies (red granules)

Images courtesy of the CDC

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Rx of choice: Palliative only. Euthanasia advised

Prognosis: No treatment

Prevention / Control:

NORTH AMERICA

- **Pet immunization** with inactivated vaccines
 - **Avoid pet-wildlife contact**
 - Pet vaccs limit virus circulation to wild reservoirs
 - **Raccoons, bats, skunks and foxes**
- 1950s-**pet vaccination laws** controlled **dog** rabies
 - Huge decrease in HUMAN rabies deaths
 - From 100s per year to 1-2 per year today
 - Today, rare human rabies cases are
 - Bat strains or in people bitten abroad by dogs

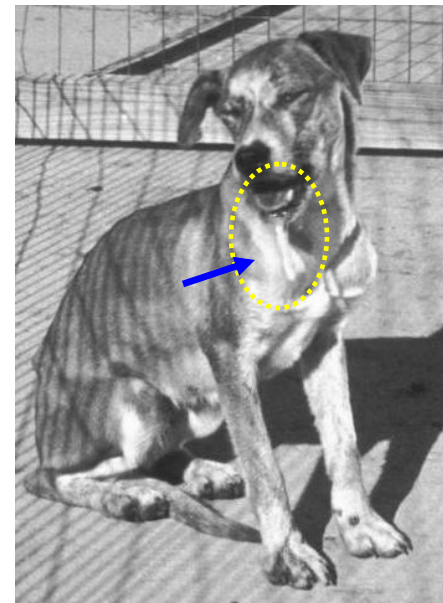


Two good reasons NOT to leave pet food outside at night. Hollywood, California.

Image courtesy, Piepie

WORLDWIDE

- More than 55,000 people die of rabies every year
 - **One person every ten minutes**
 - Mostly in **Africa, Asia, Latin America**
 - **RABID DOGS cause 99% of human rabies deaths worldwide.**
- Global rabies control recommendations modeled after successful programs in North America and Europe
- **Successful rabies control focuses on DOGS**
 - 1) **Notification** of suspected cases, and **euthanasia** of dogs w/ clinical signs and dogs bitten by a suspected rabid animal
 - 2) **Reduce contact** rates between susceptible dogs by leash laws, dog movement control, and quarantine
 - 3) **Mass immunization** of dogs by campaigns and by continuing vaccination of young dogs
 - 4) **Stray dog control** and euthanasia of unvaccinated dogs with low levels of dependency on, or restriction by, humans
 - 5) **Dog registration**



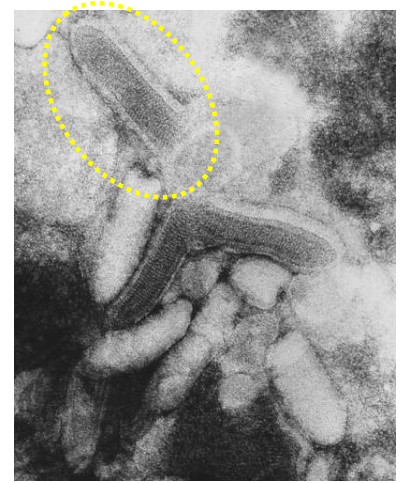
Dog with rabies, note hypersalivation
Image courtesy, CDC

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Pearls: Rabies is genus **Lyssavirus**, family **Rhabdoviridae**

- Transmitted via saliva, usually through a bite wound
- Rabies virus passes through neurons in a retrograde fashion
- Initially hyperactivity of neurons occurs
 - Hyperesthesia
 - Tremors, straining, salivation
- Later neurons die
 - Flaccid paralysis, dysphagia
 - Anesthesia
- **Did you know?**
 - Vesicular stomatitis virus (VSV) is also a rhabdovirus
 - Remember that VSV is seen in horses, cattle and pigs
 - A big rule out for Foot-And-Mouth, seen only in cows, pigs



*Rhabdoviridae: Note the bullet-like shape of these virions.
Image courtesy, CDC*

Refs: A Practical Guide to Canine and Feline Neurology, Dewey, 2nd ed. p 178, 179, Veterinary Neuroanatomy and Clinical Neurology, de Lahunta and Glass, 3rd ed. p 162, 313, Small Animal Neurology, Jaggy. p 404-406, Large Animal Neurology, Mayhew, 2nd ed. p248-250 and Merck Manual, 10th ed (online): Rabies, The Center for Food Security & Public Health and Iowa State University College of Veterinary Medicine: Rabies

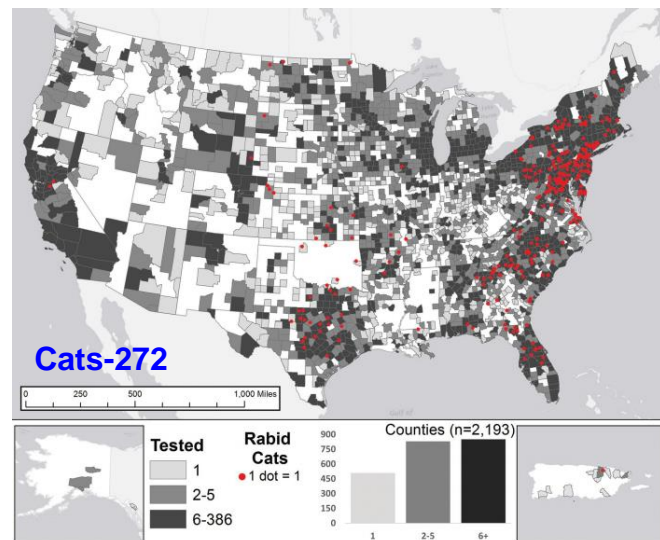
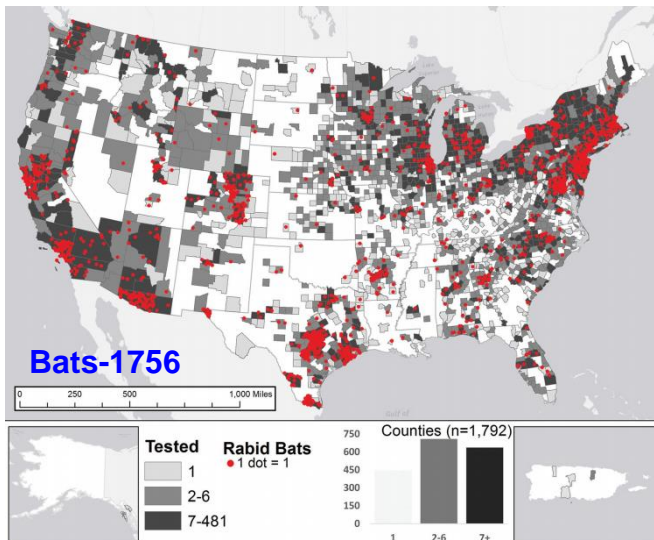
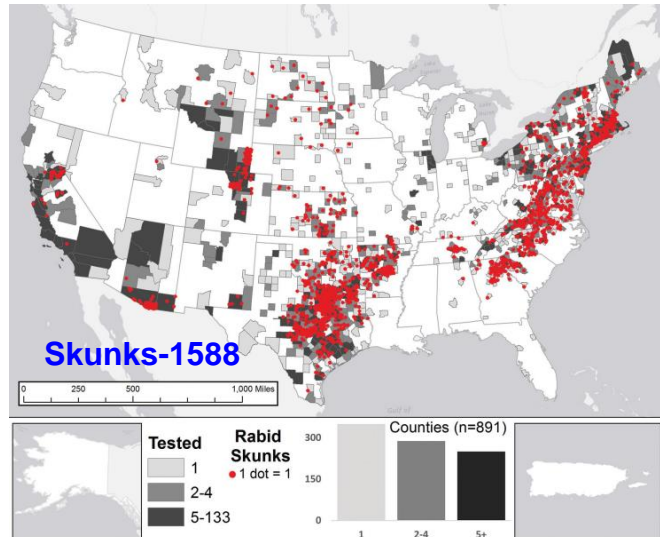
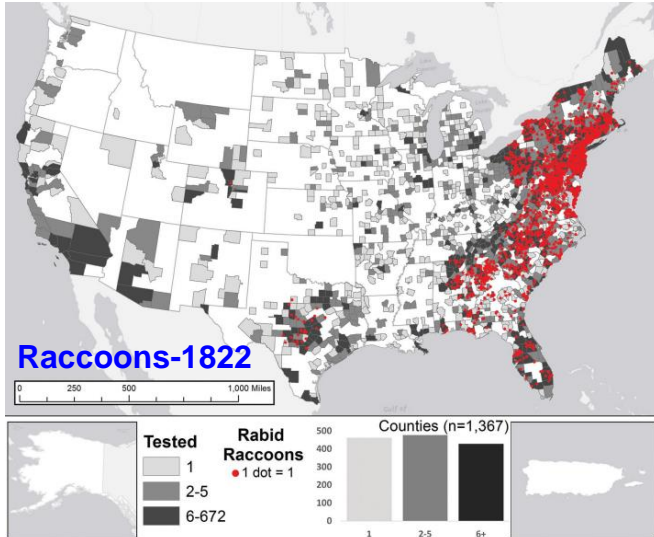


*Two dogs afflicted with **dumb rabies**, manifested by depression, lethargy and a seemingly overly tame disposition.
Image courtesy, CDC*

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Rabid Animals Reported in the United States by County, 2014



Note that lab-confirmed rabid bats number in **hundreds** in some areas; other animals measure in tens.

Note also the geographic overlap between raccoon/skunk cases and cat cases.
Feline cases (272) outnumber confirmed canine cases (58) about 5:1

Maps courtesy of CDC, Poxvirus and Rabies branch
<http://www.cdc.gov/rabies/pdf/2014-us-rabies-surveillance-508.pdf>

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Potential Rabies Exposures: What do you do?

Any healthy domestic dog, cat, or ferret, **whether vaccinated against rabies or not**

- That exposes a person (bites or deposits saliva in a fresh wound or on a mucous membrane)
- **Confine for 10 days;**
 - If animal develops any signs of rabies during that period,
 - Euthanize and send brain on ice to state lab for rabies testing
- If pet still normal after 10 days, generally vaccinate for rabies and then turn over to owner

Basically all potential rabies exposures boil down to **two questions**:

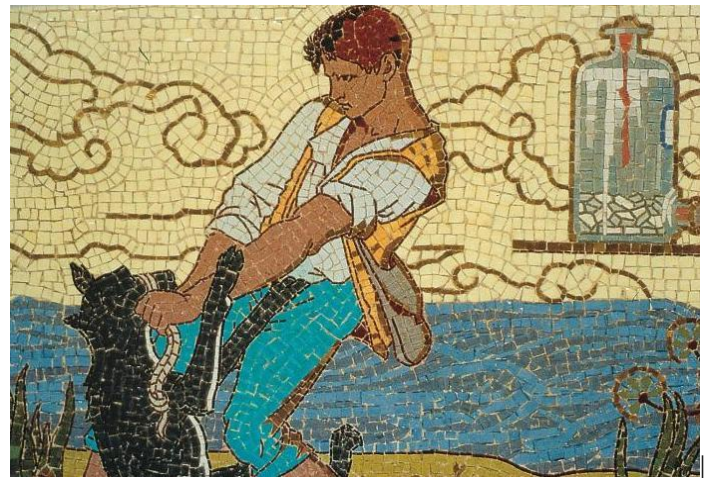
1. Who is involved?

Animal bites another animal -fewer alarm bells

Animal bites a person -more alarm bells

2. Was the animal vaccinated/up-to-date?

- Up-to-date on vaccination?
 - Fewer alarm bells
 - Shorter observation (45 days)
- Vaccinated, but out of date?
 - Grey area
 - Actions depend on situation
 - ie: bitten by a mouse?
 - vs: bitten by slobbering raccoon or a flopping bat in broad daylight?
- Un-vaccinated pet?
 - More alarm bells, guidelines are pretty clear
 - Long observation period (6 months)
 - Or euthanize
 - In real life, actions still depend on situation
- Wild animal, esp. bat, raccoon, skunk
 - Euthanize (if you have the beast)
 - Send head to state lab



Mosaic from Louis Pasteur's crypt (1896, Institut Pasteur) representing the well-known episode of the shepherd Jean-Baptiste Jupille (second person ever to be vaccinated against rabies) struggling against a rabid dog.

When dealing with a rabies question, ask yourself if this seems like a HIGH-RISK exposure (i.e.: wild raccoon bites a child) or a LOWER risk exposure (i.e.: up-to-date vaccinated dog messes with a woodchuck but no bite wounds on the dog).

For high risk, lean towards euthanasia/testing or long quarantine. For low risk lean towards short observation period and a rabies booster.

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The SINGLE BEST REFERENCE on rabies for vets is:

[Compendium for Rabies Prevention and Control, 2016](#)

JAVMA, Vol 248, No. 5., 505-517, courtesy, Natl. Assoc. State Public Health Veterinarians

In general, both Canadian and U.S. guidance on rabies post exposure management conforms with Compendium guidelines.

You DON'T need to know every state or province's rabies regs. If in doubt, follow these guidelines or choose something on the test like "Check with/Report to local health authorities."

Other resources:

For information on post-exposure prophylaxis in people see: [Human Rabies Prevention-US](#), 2008 ACIP Reccs: May 23, 2008 / 57(RR03);1-26,28.

Canadian Food Inspection Agency (CFIA) [rabies home page](#) and [rabies testing summary](#).

The Canadian Vet Med Association (CVMA) on [rabies guidance homepage](#).
[CVMA post-exposure management summary](#).

[CVMA post-exposure management presentation](#).

Global guidelines WHO OIE [World Health Organization Expert Consultation on Rabies](#) (2nd Report, 2013).



*Dog with rabies
Image courtesy, CDC*

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Key points from the compendium

CURRENTLY VACCINATED dogs, cats, and ferrets should be revaccinated immediately, kept under the owner's control, and observed for 45 days. Any illness in an isolated or confined animal should be reported immediately to the local health department.

Dogs and cats that are OVERDUE for a booster vaccination and that **HAVE DOCUMENTATION** of having received a USDA-licensed rabies vaccine at least once previously should immediately receive veterinary medical care for assessment, wound cleansing, and booster vaccination. The animal should be kept under the owner's control and observed for 45 days.

Dogs and cats that are OVERDUE for a booster vaccination and **WITHOUT DOCUMENTATION** of having received a USDA-licensed rabies vaccine at least once previously should immediately receive veterinary medical care for assessment, wound cleansing, and consultation with local public health authorities.

Ferrets that are OVERDUE for a booster vaccination should be evaluated on a CASE-BY-CASE, basis.

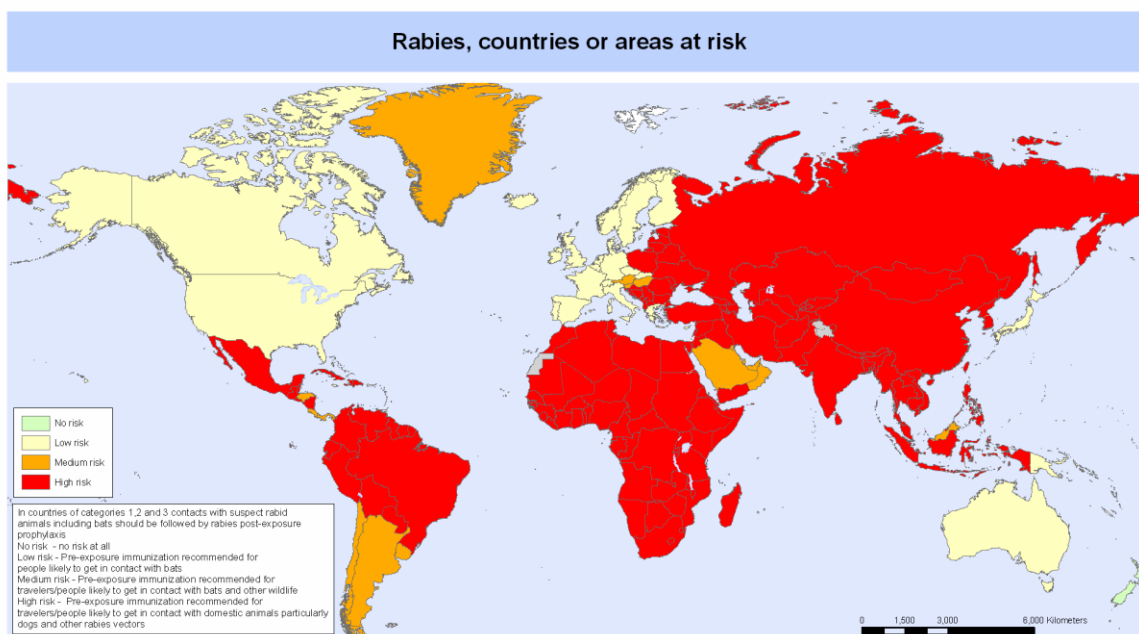
UNVACCINATED dogs, cats, and ferrets exposed to a rabid animal should be euthanized immediately.

If the owner is unwilling to euthanize,

- The animal should be placed in **strict isolation for 4 months (dogs and cats) or 6 month (ferrets).**
- Rabies vaccine should be administered upon entry into isolation.

Isolation in this context refers to confinement in an enclosure that precludes direct contact with people and other animals. Administration of vaccine should be done as soon as possible.

*Rabies Risk by Country or Area, High risk=red, Low risk=tan
(Image courtesy, WHO)*



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: WHO Rabnet/CDC
Map Production: Public Health Information and Geographic Information Systems (GIS)
World Health Organization

World Health Organization
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