Rabies Prevention:

Pathogenesis, Exposure, and Implications for animal management

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Fundamentals

- Epizootiology
  - Estimate of risk in an individual animal
- Exposure
  - Estimate of risk of the incident
    - Circumstances
    - Severity
- Management
  - Rules, regulations, and expert guidance

Why is rabies prevention important in the US?

Because animal and human travel keeps us at-risk

- Imported cases of dogs
  - From Puerto Rico to MA
  - From Thailand to CA
  - From India through WA to Alaska
  - From Iraq to the USA

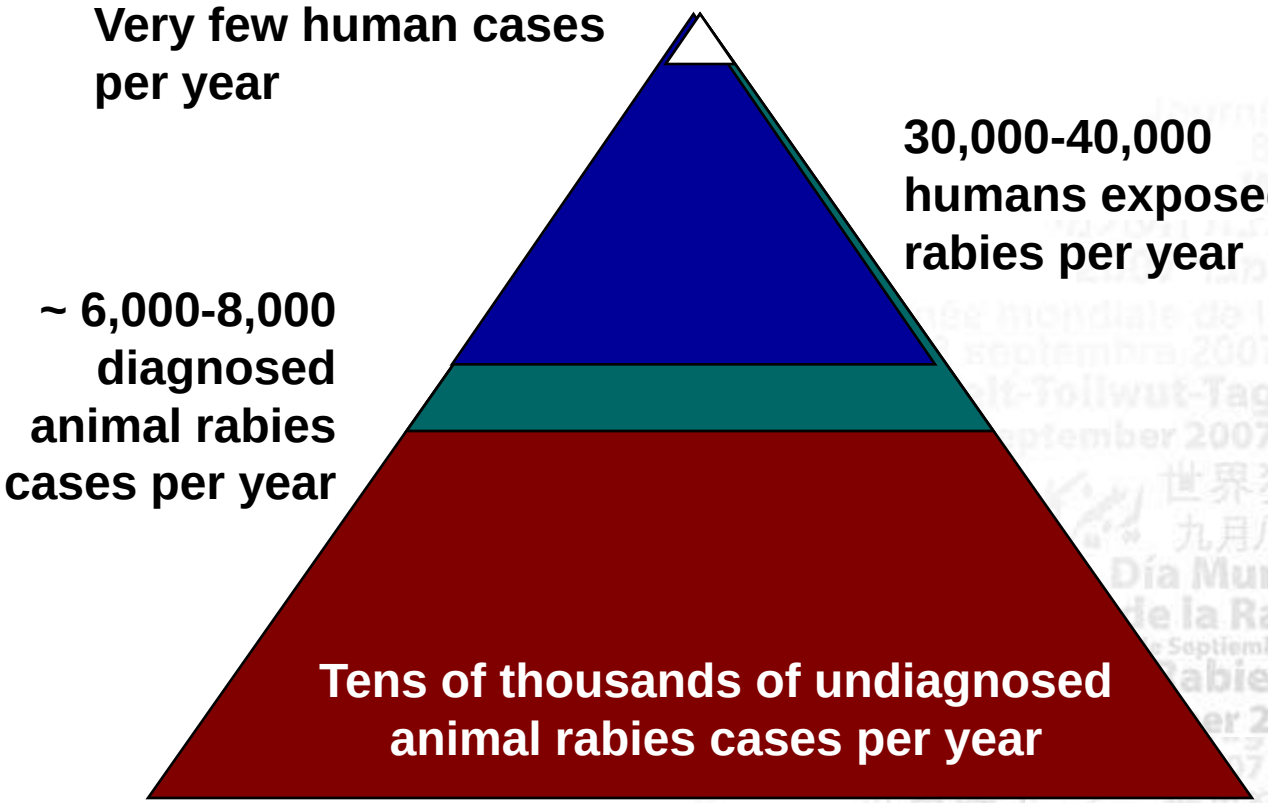
Canine rabies virus variants

and widespread sources from wildlife reservoir species.

- Over 7,250 animal cases in 2007.

Wildlife rabies virus variants

Rabies in the USA



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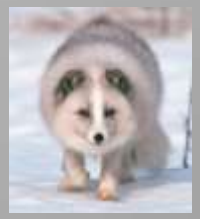
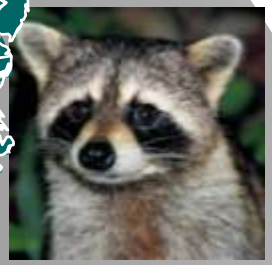


Arctic Fox

NC Skunk

CA Skunk



Raccoon

AZ Gray Fox

TX Gray Fox

SC Skunk

TX Coyote

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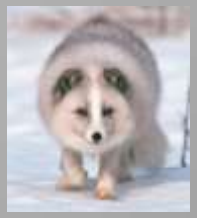

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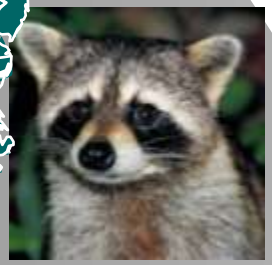

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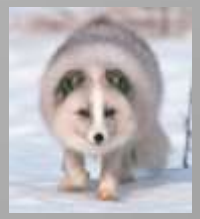

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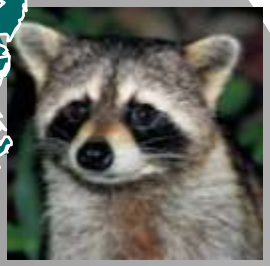
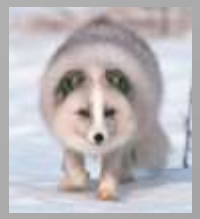


Raccoon

SC Skunk

- 2659 raccoons
- 1973 bats
- 1478 skunks
- 32 Mongoose (PR)

Why is rabies prevention important?



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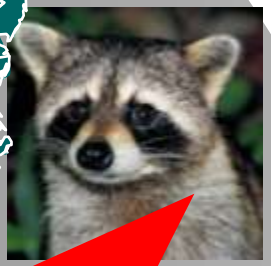

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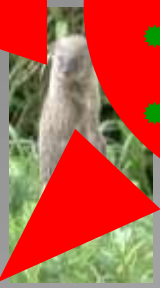


- 2659 raccoons
- 1973 bats
- 1478 skunks
- 32 Mongoose (PR)

- 274 Cats
- 93 Dogs
- 57 Cattle
- 42 Horses

Common misconceptions….

Dogs and rabies……

- Worldwide – dogs are the most important and common source of human exposure.
- Dog rabies remains uncontrolled in many parts of Africa and Asia.
- This is no longer true in the USA and many other parts of the world where vaccination of dogs and control of strays has eliminated the canine rabies virus variant.

Pathogenesis

Virus goes up the nerves into the spinal cord and brain.

Brain infection – animal begins to act differently, including being driven to bite. Virus may be present in the saliva.

aggressive
very ill

Bite – virus may replicate locally.

Bite — Incubation (non-infectious) — Viral shedding and illness — Death

10 days – 6 months or possibly more (humans - several weeks to several months……)

on the order of days

Incubation Period
Variable: several weeks to months

Clinical Period
Relatively short: < 24 hr to > 7 days

Exposure **Infectious** **Death**

Situation: Naïve (outdated), exposed domestic animal

Question: Will the animal develop rabies?

Option 1 – Euthanitize or slaughter if feed animal
to prevent the incubation and manifestation of rabies.

Option 2 – Strict quarantine for 6 months
to see if the animal develops rabies.

Potential future option – Efficacious
post-exposure prophylaxis
similar to human rabies prevention.

Situation: Biting dog, cat or ferret (owned, healthy)
Bites from other species are handled on
a case-by-case basis.

Question: Is the animal infectious?

Option 1 – Confine and observe for 10 days.
If alive and well, was not infectious.
Does not rule-out the possibility of
developing rabies in the future.

Option 2 – Euthanitize and test for rabies.

Potential future option – Antemortem rabies test.
Major drawback – shedding of virus can be
intermittent. Positive results are definitive.
Negative results are nearly meaningless.

Incubation Period
Variable: several weeks to months

Clinical Period
Relatively short: < 24 hr to > 7 days

Exposure ——— **Infectious** ——— **Death**

Situation: Currently vaccinated, exposed domestic animal

Management: 1) Prompt wound care
2) booster vaccination
3) 45 day confinement

Incubation Period
Variable: several weeks to months

Clinical Period
Relatively short: < 24 hr to > 7 days

Exposure ——— **Infectious** ——— **Death**

Situation: Naïve (outdated), exposed domestic animal bitten by a rabid animal and also bit someone during the fight

Question: Will the animal develop rabies?

Option 1 – Strict quarantine for 6 months
to see if the animal develops rabies.

Option 2 – Euthanitize; must test for rabies.
to prevent the incubation and manifestation of rabies.

Question: Is the animal infectious right now?

Option 1 – Confine and observe for 10 days.
If alive and well, was not infectious.
Does not rule-out the possibility of developing rabies in the future.

Option 2 – Euthanitize and test for rabies.

Exposure

- **Bite is the most natural and successful way to transmit rabies.**
  - Exposing fresh, open bleeding wounds to live virus (i.e., fresh saliva or tissue)
    - Oral exposure (consuming large amounts of live virus) may result in rabies but the risk is orders of magnitude lower.
    - Inhalation of droplets or an aerosol
      - Ocular – not documented except with corneal transplant

Exposure

- …..petting or handling an animal, contact with blood, urine or feces, and contact of saliva with intact skin does not constitute an exposure

- Potential exposures to bats - pose a greater risk for infecting humans under certain circumstances that might be considered inconsequential from a human perspective (i.e., a minor bite or lesion).
- If ….bite, scratch, or mucous membrane exposure did not occur, or if the tests negative – no exposure.
- finding a bat in the same room as a person who might be unaware that a bite or direct contact had occurred (e.g., a deeply sleeping person awakens to find a bat in the room or an adult witnesses a bat in the room with a previously unattended child, mentally disabled person, or intoxicated person) may represent an exposure.

Online Resources for US Practitioners

- CDC
  - **"The ACIP"** – Advisory Committee on Immunization Practices – Human Rabies Prevention
    - 2008 and 1999
  - "**Compendium**" of Animal Rabies Control – Annual
  - "**Annual rabies surveillance**" data – JAVMA
- USDA
  - http://www.aphis.usda.gov/animal_health/vet_biologics/index.shtml
  - **Veterinary Biologics**
    Report adverse events
- World Health Organization
  - Global data
    (limited – consult with CDC Rabies Team)

Major Prevention Techniques

- Control in the reservoir species
  - Domestic dog: methodical vaccination
  - Wild carnivores: oral vaccine in baits
- Prevention of “spillover” domestic species
  - Vaccination
- Prophylaxis for exposed humans
  - Immediate wound cleansing
  - Vaccination series (*cell culture vaccines*)
  - Rabies immunoglobulin

Common misconceptions….

Dogs bites and urgent human prophylaxis …

In the USA, when a ***dog***, ***cat*** or ***ferret*** has bitten or otherwise potentially exposed someone and is available for observation or euthanasia and testing,

the need for human rabies post-exposure prophylaxis should be based on the outcome of the

10-day observation period

or the ***laboratory result***.

Prophylaxis based on

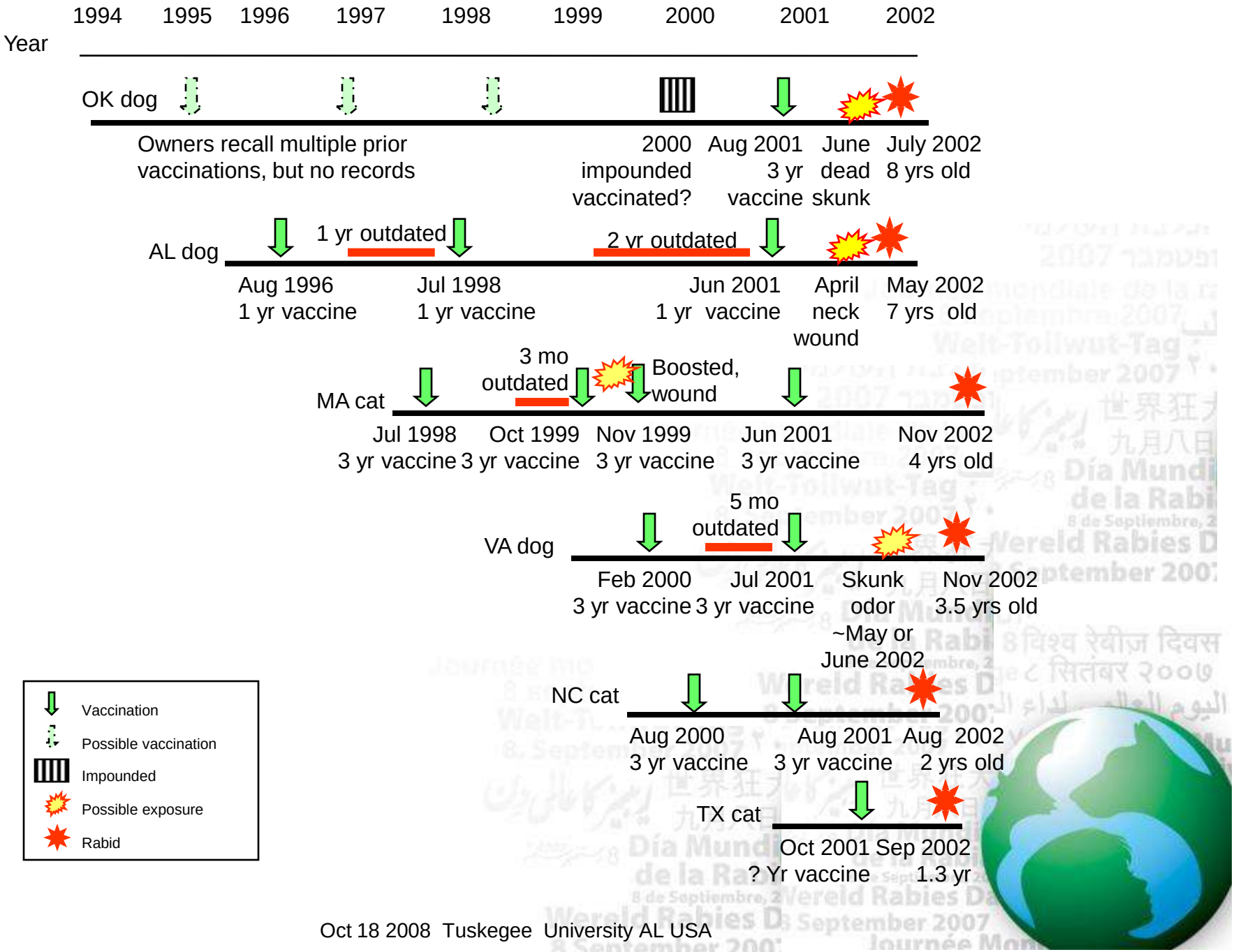
- Laboratory Diagnosis,
  - if available within 48 hours
  - consider species and risk
- If a dog, cat or ferret that bit someone is available:
  - Healthy, observe under confinement for 10 days
  - Clinically abnormal, euthanize, test brain, make post-exposure prophylaxis decision…..

Why 10 day observation?

- No vaccine is 100% effective.

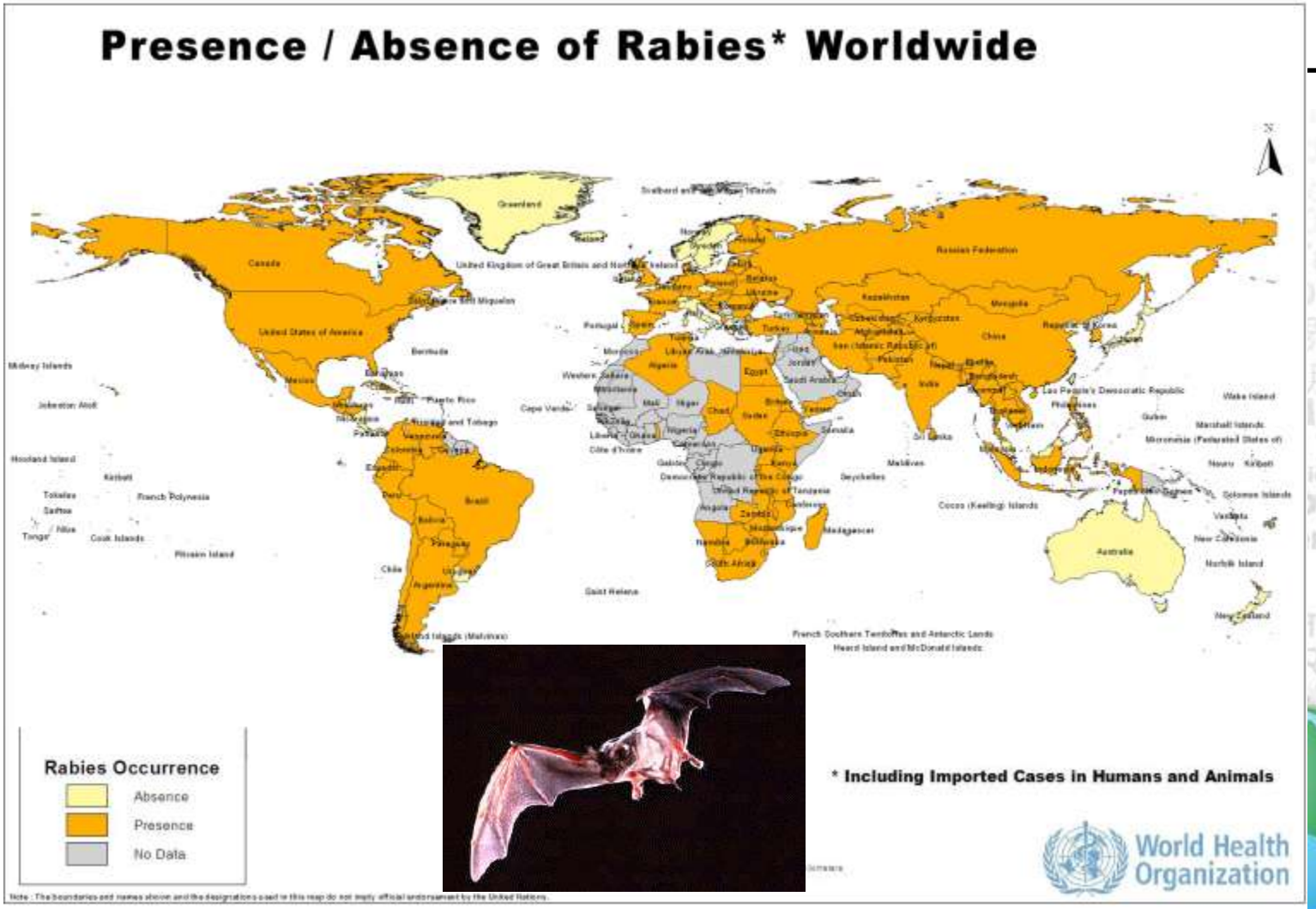
Rabies in vaccinated animals: 2002

- OK dog
  - 8 yr old male Siberian Husky.
- AL dog
  - 7yr old female Boston Terrier.
- NC cat
  - 2-yr-old spayed female domestic short-haired cat.
- TX cat
  - 1yr-4-mo-old cat.
- VA dog
  - Spayed female German shepherd.
- MA cat
  - 4-yr-old neutered male lynx pt Siamese cat


1994
1995
1996
1997
1998
1999
2000
2001
2002
Year
OK dog
Owners recall multiple prior vaccinations, but no records
2000 impounded vaccinated?
Aug 2001 3 yr vaccine
June dead skunk
July 2002 8 yrs old
AL dog
1 yr outdated
2 yr outdated
Aug 1996 1 yr vaccine
Jul 1998 1 yr vaccine
Jun 2001 1 yr vaccine
April neck wound
May 2002 7 yrs old
MA cat
3 mo outdated
Boosted, wound
Jul 1998 3 yr vaccine
Oct 1999 3 yr vaccine
Nov 1999 3 yr vaccine
Jun 2001 3 yr vaccine
Nov 2002 4 yrs old
VA dog
5 mo outdated
Feb 2000 3 yr vaccine
Jul 2001 3 yr vaccine
Skunk odor ~May or June 2002
Nov 2002 3.5 yrs old
NC cat
Aug 2000 3 yr vaccine
Aug 2001 3 yr vaccine
Aug 2002 2 yrs old
TX cat
Oct 2001 ? Yr vaccine
Sep 2002 1.3 yr
Vaccination
Possible vaccination
Impounded
Possible exposure
Rabid

Humans travel, animals are moved….

and bats fly.


Presence / Absence of Rabies* Worldwide
Rabies Occurrence
Absence
Presence
No Data
* Including Imported Cases in Humans and Animals
World Health Organization

Rabies cannot be eradicated

but the main global source can be eliminated.