Investigation of potential rabies exposure situations

Sarah Scotland, MPH

Epidemiologist

Division of Epidemiology and Immunization

Bureau of Infectious Disease and Laboratory Sciences

Massachusetts Department of Public Health
What is rabies?

• Rabies is a serious **viral** disease that affects the brain and spinal cord of mammals (ex. dogs, cats, raccoons, foxes, humans)

• Primarily a disease of animals, but can spread from an infected animal to a person

• Rabies virus is present in the saliva and central nervous system (CNS) tissue of infected animals
  • Blood, urine, feces, skunk spray and fur of animals are not infectious
  • Outside the animal, rabies virus does not survive long
  • Virus does not survive long in dead animals
How is the virus transmitted?

- A person is considered **exposed** if they were:
  - Bitten by a rabid animal
  - Saliva or CNS tissue has gotten into recently bleeding open cut or mucous membrane (eyes, nose, mouth)

- A bite is by far the most efficient transmission mechanism
“Indirect” Rabies Exposures

- Possible indirect exposures
  - Handling pets after fight with wildlife
    - Saliva from wildlife on pet?
    - Open wounds on hands?
    - Touching of mucous membranes?

- There have been no documented cases of human rabies from indirect exposures but it is theoretically possible
Human Rabies

- Around 55,000 people die of rabies each year around the world
- Extremely rare in the US
  - ~ 1 or 2 cases per year
- Extremely rare in Massachusetts
  - <5 cases since 1992
- Virtually always fatal
- 100% preventable after an exposure with post-exposure prophylaxis (PEP)
Rabies Surveillance Data in Massachusetts 1992-2017
## How common is Rabies in Massachusetts?

<table>
<thead>
<tr>
<th>Species</th>
<th>Positive</th>
<th>Total</th>
<th>% Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>RACCOON</td>
<td>3302</td>
<td>8471</td>
<td>39.0</td>
</tr>
<tr>
<td>SKUNK</td>
<td>1827</td>
<td>5539</td>
<td>33.0</td>
</tr>
<tr>
<td>BAT</td>
<td>656</td>
<td>17213</td>
<td>3.8</td>
</tr>
<tr>
<td>FOX</td>
<td>224</td>
<td>1064</td>
<td>21.1</td>
</tr>
<tr>
<td>CAT</td>
<td>191</td>
<td>25729</td>
<td>0.7</td>
</tr>
<tr>
<td>WOODCHUCK</td>
<td>124</td>
<td>2120</td>
<td>5.8</td>
</tr>
<tr>
<td>COW</td>
<td>15</td>
<td>127</td>
<td>11.8</td>
</tr>
<tr>
<td>COYOTE</td>
<td>14</td>
<td>166</td>
<td>8.4</td>
</tr>
<tr>
<td>BOBCAT</td>
<td>10</td>
<td>19</td>
<td>52.6</td>
</tr>
<tr>
<td>DOG</td>
<td>9</td>
<td>11033</td>
<td>0.1</td>
</tr>
<tr>
<td>HORSE</td>
<td>6</td>
<td>203</td>
<td>3.0</td>
</tr>
<tr>
<td>OTTER</td>
<td>4</td>
<td>10</td>
<td>40.0</td>
</tr>
<tr>
<td>PIG</td>
<td>4</td>
<td>51</td>
<td>7.8</td>
</tr>
<tr>
<td>FISHER</td>
<td>3</td>
<td>46</td>
<td>6.5</td>
</tr>
<tr>
<td>GOAT</td>
<td>3</td>
<td>187</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6400</strong></td>
<td><strong>77693</strong></td>
<td><strong>8.2</strong></td>
</tr>
</tbody>
</table>
## Rabies data by county level 1992-2017

<table>
<thead>
<tr>
<th>County</th>
<th>Positive</th>
<th>Total</th>
<th>% Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnstable</td>
<td>400</td>
<td>4312</td>
<td>9.3</td>
</tr>
<tr>
<td>Berkshire</td>
<td>330</td>
<td>2195</td>
<td>15.0</td>
</tr>
<tr>
<td>Bristol</td>
<td>718</td>
<td>6531</td>
<td>11.0</td>
</tr>
<tr>
<td>Dukes</td>
<td>0</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>Essex</td>
<td>704</td>
<td>9544</td>
<td>7.4</td>
</tr>
<tr>
<td>Franklin</td>
<td>194</td>
<td>1483</td>
<td>13.1</td>
</tr>
<tr>
<td>Hampden</td>
<td>351</td>
<td>4187</td>
<td>8.4</td>
</tr>
<tr>
<td>Hampshire</td>
<td>182</td>
<td>1788</td>
<td>10.2</td>
</tr>
<tr>
<td>Middlesex</td>
<td>1111</td>
<td>15170</td>
<td>7.3</td>
</tr>
<tr>
<td>Nantucket</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>Norfolk</td>
<td>731</td>
<td>9219</td>
<td>7.9</td>
</tr>
<tr>
<td>Plymouth</td>
<td>594</td>
<td>6530</td>
<td>9.1</td>
</tr>
<tr>
<td>Suffolk</td>
<td>177</td>
<td>6973</td>
<td>2.5</td>
</tr>
<tr>
<td>Worcester</td>
<td>907</td>
<td>9505</td>
<td>9.5</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>80</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6400</strong></td>
<td><strong>77693</strong></td>
<td><strong>8.2</strong></td>
</tr>
</tbody>
</table>
Figure 1: Numbers of Animals Positive for Rabies and Percent Positive by Year: Massachusetts, 1993-2017

- **Number of Positives**
  - Red bars: Terrestrial Animals
  - Blue bars: Bats
  - Black line with triangles: Percent Positive (Terrestrial)

- **Percent of Positives out of Submissions**
  - Y-axis: 0% to 20%
  - X-axis: Years 1993 to 2017
2017 Rabies Surveillance Data in Massachusetts
### 2017 Rabies data by animal submission

<table>
<thead>
<tr>
<th>Animal</th>
<th># Positive</th>
<th># Submitted</th>
<th>% Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raccoon</td>
<td>34</td>
<td>115</td>
<td>29.6</td>
</tr>
<tr>
<td>Skunk</td>
<td>20</td>
<td>87</td>
<td>23.0</td>
</tr>
<tr>
<td>Bat</td>
<td>20</td>
<td>920</td>
<td>2.2</td>
</tr>
<tr>
<td>Fox</td>
<td>11</td>
<td>30</td>
<td>36.7</td>
</tr>
<tr>
<td>Woodchuck</td>
<td>8</td>
<td>86</td>
<td>9.3</td>
</tr>
<tr>
<td>Coyote</td>
<td>1</td>
<td>10</td>
<td>10.0</td>
</tr>
<tr>
<td>Cat</td>
<td>1</td>
<td>597</td>
<td>0.2</td>
</tr>
<tr>
<td>Bob Cat</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cow</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Dog</td>
<td>0</td>
<td>520</td>
<td>0</td>
</tr>
<tr>
<td>Other*</td>
<td>0</td>
<td>85</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96</strong></td>
<td><strong>2453</strong></td>
<td><strong>3.9</strong></td>
</tr>
</tbody>
</table>
## Submissions, Number Positive for Rabies, and Percent Positive by Month and Animal Type

<table>
<thead>
<tr>
<th>Month</th>
<th>Terrestrial Animals</th>
<th>Bats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Submissions</td>
<td>Positive (n,%)</td>
</tr>
<tr>
<td>January</td>
<td>113</td>
<td>6</td>
</tr>
<tr>
<td>February</td>
<td>88</td>
<td>4</td>
</tr>
<tr>
<td>March</td>
<td>117</td>
<td>2</td>
</tr>
<tr>
<td>April</td>
<td>103</td>
<td>6</td>
</tr>
<tr>
<td>May</td>
<td>140</td>
<td>6</td>
</tr>
<tr>
<td>June</td>
<td>191</td>
<td>8</td>
</tr>
<tr>
<td>July</td>
<td>177</td>
<td>5</td>
</tr>
<tr>
<td>August</td>
<td>168</td>
<td>11</td>
</tr>
<tr>
<td>September</td>
<td>122</td>
<td>9</td>
</tr>
<tr>
<td>October</td>
<td>120</td>
<td>4</td>
</tr>
<tr>
<td>November</td>
<td>119</td>
<td>9</td>
</tr>
<tr>
<td>December</td>
<td>75</td>
<td>6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1533</strong></td>
<td><strong>76</strong></td>
</tr>
</tbody>
</table>
## 2017 Rabies data by county level

<table>
<thead>
<tr>
<th>County</th>
<th>Number Positive</th>
<th>Number Submitted</th>
<th>% Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnstable</td>
<td>0</td>
<td>96</td>
<td>0%</td>
</tr>
<tr>
<td>Berkshire</td>
<td>7</td>
<td>76</td>
<td>9.2%</td>
</tr>
<tr>
<td>Bristol</td>
<td>11</td>
<td>164</td>
<td>6.7%</td>
</tr>
<tr>
<td>Dukes</td>
<td>0</td>
<td>6</td>
<td>0%</td>
</tr>
<tr>
<td>Essex</td>
<td>15</td>
<td>287</td>
<td>5.2%</td>
</tr>
<tr>
<td>Franklin</td>
<td>11</td>
<td>46</td>
<td>23.9%</td>
</tr>
<tr>
<td>Hampden</td>
<td>6</td>
<td>141</td>
<td>4.3%</td>
</tr>
<tr>
<td>Hampshire</td>
<td>4</td>
<td>77</td>
<td>5.2%</td>
</tr>
<tr>
<td>Middlesex</td>
<td>12</td>
<td>524</td>
<td>2.3%</td>
</tr>
<tr>
<td>Nantucket</td>
<td>0</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Norfolk</td>
<td>6</td>
<td>277</td>
<td>2.2%</td>
</tr>
<tr>
<td>Plymouth</td>
<td>0</td>
<td>200</td>
<td>0%</td>
</tr>
<tr>
<td>Suffolk</td>
<td>2</td>
<td>191</td>
<td>1%</td>
</tr>
<tr>
<td>Worcester</td>
<td>22</td>
<td>366</td>
<td>6.0%</td>
</tr>
</tbody>
</table>
What are the appropriate steps after a potential rabies exposure?

- Identify the animal
  - If exposing animal is a dog, cat, ferret or cow, implement 10-day quarantine.
  - If exposing animal is a high-risk wild animal, submit for testing.
  - If it involves a lower risk animal, call MDPH to consult.

- Depending on results of testing or quarantine, post-exposure prophylaxis (PEP) may be recommended.
### Species Considerations For Rabies Testing

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
<th>Category 3</th>
<th>Category 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALWAYS test following human or domestic animal exposure. Species in this group are either known rabies vectors or are considered likely to have the potential to transmit rabies.</td>
<td>Test following human or domestic animal exposure if 10-day quarantine is not possible or not appropriate (i.e., animal is already ill). Species in this group can only transmit rabies up to 10 days before showing symptoms.</td>
<td>Requires MDPH or MDAR* approval for testing (handled case by case). Species in this group are occasionally found to be rabid although bites from these animals have never resulted in a human case of rabies in the United States.</td>
<td>Rabies testing NOT indicated. Species in this group are virtually never found to be rabid and bites from these animals have never resulted in a human case of rabies in the United States.</td>
</tr>
</tbody>
</table>

- **Bat**
- **Bear**
- **Beaver**
- **Bobcat**
- **Coyote**
- **Fisher**
- **Fox**
- **Otter**
- **Raccoon**
- **Skunk**
- **Woodchuck**

- **Cat**
- **Cow**
- **Dog**
- **Ferret**

- **Alpaca/llama**
- **Chinchilla**
- **Deer**
- **Domestic/pet rabbit**
- **Goat**
- **Guinea pig**
- **Horse**
- **Mink**
- **Moose**
- **Muskrat**
- **Opossum**
- **Porcupine**
- **Pig**
- **Squirrel**
- **Weasel**

*Massachusetts Department of Agricultural Resources: 617-626-1786*

For exposures involving an animal species not specifically listed OR unusual circumstances, consultation with the Massachusetts Department of Public Health Division of Epidemiology and Immunization is available 24/7 at 617-983-6800.
10-day quarantine

• Recommended for cats, dogs, cows, and ferrets as there is documented literature on shedding periods – established length of time that an animal could have virus in its saliva prior to death

  – Studies show that virus is in the animal’s saliva for a few days prior to death, 10 days includes a large buffer period

• If a human is exposed on Day 0 and the animal is alive and well on Day 10, no testing or PEP is necessary

• Quarantines issued by local Animal Inspectors (AI) as agents of the Department of Agricultural Resources (DAR)
Specimen submission

- Rabies lab tests specimens Monday-Friday, but specimens can be dropped off 24 hours/day, 7 days a week
- Residents are asked to contact local Animal Inspectors (AI) or Animal Control Officers (ACO) to request assistance with specimen submission
- Bats can be submitted whole, but other species must be euthanized and prepared by a veterinarian (head only)
- Specimens should be kept cold, never frozen
  - If a specimen is accidentally frozen, keep it frozen during shipping
- Any specimen received by noon will have a result by end of work day
Post Exposure Prophylaxis (PEP)

- Recommended for any human exposure to a potentially rabid animal if quarantine or testing is not possible

- Recommended vaccine schedule: Day 0 (+ HRIG), Day 3, Day 7, and Day 14
  - Day 28 (5th dose) recommended for immunocompromised individuals
  - Anyone who has previously completed the series only needs two booster doses of vaccine on Day 0 and Day 3
  - Vaccine often available only in an Emergency Department

- Insurance covers post-exposure prophylaxis (to the limit of the plan)
Pre-Exposure Prophylaxis

• Pre-exposure prophylaxis recommended for certain high-risk groups (ex. veterinarians, students)

• Recommended vaccine schedule: Day 0 Day 7, and Day 21 or 28

• Insurance rarely covers pre-exposure prophylaxis

• Usually available at hospital-affiliated travel clinics
Wound care

• Whether or not rabies PEP is recommended, a bite victim may need to see their provider for wound care:
  • Cleaning
  
  • Closure
  
  • Antibiotics
  
  • Tetanus vaccination (if indicated)
ROLE OF MDPH, DAR, LBOH IN RABIES EXPOSURE INVESTIGATIONS
Role of MDPH

• Rabies Lab:
  – Tests animal specimens for virus (only lab in state)

• Epidemiology Program:
  – Responds to inquiries from healthcare providers, veterinarians, Animal Control Officers (ACOs), Animal Inspectors (AIs), and members of the public about possible exposures
  – Conducts human risk assessments and make recommendations around 10-day quarantines for animals, specimen submission, and PEP
  – Report positive and unsatisfactory results
Role of LBOH / ACO / AI

• Responsible for public health of residents in their jurisdiction.

• Attempt to identify and capture animals that bit or scratched residents in their jurisdiction.

• Critical role to assist in identifying exposing animals and specimen submission if necessary.

• Should develop and maintain relationship(s) with local veterinarians who can assist with euthanasia and specimen submission.
Role of Animal Inspector (AI)

- Regulatory authority
  - to ensure exposing animals are submitted for rabies testing.
  - Implement a 10-day quarantine for cats, dogs, cows, and ferrets.
Typical scenarios

- Bat in house
- Wildlife exposure
- Domestic animal bite
- Livestock exposure
Comparison of wound from a silver-haired bat bite with the a silver-haired bat skull.

Alan Jackson and Brock Fenton
Lancet Vol. 457, Page 1714 (May 26 2001)
Bat in house

- Bite marks not always noticeable
- What is considered an exposure?:
  - Known bite or scratch
  - Direct contact if a bite or scratch cannot be ruled out
  - Bat found in room with previously unattended child or incapacitated adult (or pet) who cannot report if an exposure has occurred
- What **MAY** be considered an exposure?:
  - Person awakes to find bat in bedroom (if person sleeps lightly, has a pet in the bedroom that would have chased the bat, is covered by sheet/blanket, etc. – exposure less likely)
- If exposure has occurred:
  - Bat should be tested (PEP recommended if positive or unsatisfactory)
  - If bat is unavailable for testing, PEP recommended
- If no exposure has occurred, PEP is not recommended
Wildlife Exposure

- High risk animal (almost all mammals except small rodents – ex. skunks, raccoons, foxes):
  - Trap and euthanize animal and submit for testing
  - PEP if animal tests positive or is unsatisfactory
  - If animal is unavailable for testing, assume rabid and PEP is recommended

- What is considered an exposure?:
  - Known bite
  - Saliva or CNS fluid / tissue in open (recently bleeding) cut or mucous membrane

- If no exposure has occurred, no testing or PEP recommended
Wildlife exposure, pet involvement

• Often, wildlife scenarios involve pets, e.g., dog fighting with raccoons

• Human exposure could be indirect:
  – Ask about how dog was handled after interaction with raccoon; was there any raccoon saliva on dog that could have gotten into human’s cut or mucous membrane? (theoretical risk)

• Also concerned about pet’s exposure:
  – Ask if pet is up-to-date on rabies vaccine
  – Recommend pet goes to vet for booster
  – Vet required to report to AI
    • Owner should be encouraged to contact AI also
Domestic Animal Bites (Dog, cat, cow, or ferret)

- If animal is known/identifiable, 10-day quarantine is required.
  - AIs/ACOs can help identify animal and issue quarantine
  - This is required regardless of vaccination status
  - Important to assess animal’s rabies risk: vaccine history, symptoms (including behavior), exposure to wildlife

- If animal does not survive 10 days after bite and/or develops symptoms compatible with rabies, euthanize and submit for testing (required by DAR regulation).

- If animal is unavailable, consider circumstances of bite. PEP *may* be recommended
Livestock exposure

- Goats, horses, pigs, and sheep all Category 3 species
- Ask about animal’s rabies risk:
  - Rabies vaccine history (request documentation)
  - Symptoms, including behavior
  - Obtain specifics for human exposure
  - Potential exposure to wildlife:
    - How is animal housed?
    - Any wounds of unknown origin?
- These scenarios typically require consultation with Zoonotic team leadership within MDPH and DAR
Small mammal exposure

- Small rodents such as squirrels, chipmunks, mice, rabbits
  - No PEP or testing unless circumstances very exceptional
Management of Patients Potentially Exposed to Rabies

Did an exposure to rabies potentially occur?
- Did a mammal (animal with fur) bite the patient?
- Did the patient's open wound, broken skin or mucous membrane contact saliva or central nervous system tissue from a mammal?
- Did the patient have direct contact with a bat such that a bite or scratch cannot be ruled out?
- Did the patient awaken to find a bat in the room or see a bat in a room with a previously unattended young child or mentally impaired person?

No
- No postexposure prophylaxis (PEP)

Yes
- Bat? Yes, Available to test? Yes, Start PEP if positive; No, Contact public health authorities
- No, Wild animal?

Yes
- High risk species? (e.g., raccoon, skunk, fox, coyote, bobcat, woodchuck) Yes, Available to test? Yes, Start PEP if positive; No, Start PEP promptly
- No
- Low risk wild species? (e.g., squirrel, chipmunk, mouse/rat, rabid/hare)

Yes
- No PEP

No
- Other or unknown?

Yes, Contact public health authorities

No
- Wild animal?

Yes
- bark or ferret?

Yes
- Healthy and available for quarantine? Yes, 10 day quarantine stays healthy? Yes, No PEP; No, Test if positive, Start PEP

No
- Unhealthy?

Yes, Test if positive, Start PEP

No, Unavailable?

Yes, Start PEP promptly

No, Other or unknown?

Contact public health authorities

No
- Small pocket pet? (e.g., guinea pig, rabbit, gerbil, hamster)

Yes
- Housed exclusively indoors?

Yes
- No PEP

No, Contact public health authorities

No
- Livestock?

Yes, Contact public health authorities

No
- Livestock?
Teamwork required between MDPH, LBOH / ACO / AI and DAR

• Goals:
  – Identify animals that need to be tested or quarantined
  – Assess risk of exposures
  – Ensure specimens requiring testing arrive at MA SPHL
  – Avoid unnecessary PEP for residents
Public Resources

- MDPH
  - www.mass.gov/dph/rabies

- CDC

- Rabies Specimen Submission Form
Questions?

Sarah Scotland, MPH
Sarah.scotland@state.ma.us
(617) 983-6800
Epidemiologist
Division of Epidemiology and Immunization
Bureau of Infectious Disease and Laboratory Sciences
Massachusetts Department of Public Health