Wildlife and Public Health Concerns

NC WRC: Rabies, Wildlife Health Workshop
August 14, 2014

Carl Williams, DVM, DACVPM
State Public Health Veterinarian
NC Division of Public Health
919-733-3410
carl.williams@dhhs.nc.gov
ZOONOTIC DISEASES

- **Zoonoses** = diseases of vertebrate animals that can be transmitted to man, *EITHER*:
  - Directly (e.g. – rabies, tularemia, avian influenza, bovine TB, brucellosis, hantavirus pulmonary syndrome, monkeypox, vCJD) *OR*
  - Indirectly via contaminated food/water (e.g. – salmonellosis, campylobacteriosis, yersiniosis, cryptosporidiosis, leptospirosis, toxoplasmosis, larva migrans, cysticercosis), *OR*
  - Indirectly through an insect vector (e.g. – Lyme disease, West Nile fever, E/W/V equine encephalitis, Chagas disease, Rift Valley fever)
Human Surveillance Data; 2009-2013

- Direct Transmission
  - Brucellosis: 7 cases in 5 years
  - Tularemia: 7 cases in 5 years
  - Rabies: 1 case in 5 years
  - Hantavirus: 0 cases in 5 years
Human Surveillance Data; 2009-2013

• Vectorborne Transmission
  – Tick borne
    • RMSF: 1867 cases in 5 years
    • Lyme disease: 567 cases in 5 years
    • Ehrlichiosis: 422 cases in 5 years
  – Mosquito borne
    • LaCrosse Encephalitis: 101 cases in 5 years
    • West Nile Virus: 13 cases in 5 years
    • Eastern Equine Encephalitis: 4 cases in 5 years
Human Surveillance Data; 2009-2013

• Foodborne Transmission
  – Salmonellosis: 11,049 cases in 5 years
  – Campylobacteriosis: 4,316 cases in 5 years
  – STEC: 604 case in 5 years
  – Cryptosporidiosis: 616 cases in 5 years
Sources of Human Infection in the U.S.

- Ingestion of imported unpasteurized dairy products
- Contact with meat and other tissues from infected animals
- **Laboratory exposures**
  - Aerosol exposure may represent a significant risk

Adapted from Slide by Rita Traxler, CDC
Laboratory-Acquired Infections (LAIs)

- **Brucellosis** - one of 10 most frequently reported LAIs in the U.S.*
  - 1930-2004 - 24% of bacterial LAIs due to *Brucella*
  - 2008: 15% (12/80) of brucellosis cases notified to NNDSS had associated laboratory exposures
  - 2009: 41% (49/120) of brucellosis cases notified to NNDSS had associated laboratory exposures
- Reported cases - underestimation of true burden
- Infections linked to inhalation of aerosols
  - Direct handling of organism
  - Routine lab procedures outside of a hood**
  - Close vicinity
  - Accidents


Adapted from Slide by Rita Traxler, CDC
Laboratory Employees Face Greater Risks
Risk of LAI in microbiologist vs. the general population, same relative age

<table>
<thead>
<tr>
<th>Organism</th>
<th>Risk/100,000 microbiologists</th>
<th>Risk/100,000 General population</th>
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<tbody>
<tr>
<td>Brucella</td>
<td>641</td>
<td>0.08</td>
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<tr>
<td>Coccidoides</td>
<td>13.7</td>
<td>12</td>
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<td>C. difficile</td>
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<td>E. coli O157:H7</td>
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<td>N. meningitidis</td>
<td>25.3</td>
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<tr>
<td>Salmonella</td>
<td>1.5</td>
<td>17.9</td>
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<tr>
<td>Shigella</td>
<td>6.6</td>
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</tr>
</tbody>
</table>


Adapted from slide by Dr. Tom Hearn, CDC
Rabies

• Clinical Disease
  – Can be elicited by all Genotypes
  – However, virtually all cases are caused by GT1
  – Prompt and properly administered post exposure treatment is 100% effective in protecting against disease
  – Nonetheless, ~55,000 human deaths from rabies are reported each year per WHO
What Makes us Different?

- **NCGS 130A-185. Vaccination of all dogs, cats and ferrets**
  - (a) The owner of every dog and cat over four months of age shall have the animal vaccinated against rabies. The time or times of vaccination shall be established by the Commission. Rabies vaccine shall be administered only by a licensed veterinarian or by a certified rabies vaccinator.
- We learned from Old Yeller and Atticus
Pet Owners

NC DPH
- Keep pets currently vaccinated

WDCA
- Assist property owners remove rabies risk animals
- Develop wildlife and rehab policy, train WDCA

Local ACO
- Enforce state rabies law, local ordinances
- Implement ORV, surveillance testing

USDA WS
- Risk assessments, coordinate PEP

Local PH

Effective Rabies Control; Prevention of Human Rabies Cases
Typical Organizational Structure for Rabies Control

Local Board of Health

Local Health Director

Communicable Disease Staff
  - Advise Clinicians, Veterinarians, Exposed Persons, Pet owners

Animal Services Officers
  - Advise Veterinarians, Pet owners, Instruct Exposed Persons to call CD staff or Health Care Provider

County Sheriff

County Manager
Understand One Another

Animal Services Agencies

Local Health Department
Communicable Disease Staff

Veterinarians

Physicians / Clinicians
Distribution of major rabies virus variants among mesocarnivore reservoirs in the United States and Puerto Rico, 2008 to 2012. *Potential host shift event

Reported cases of rabies involving raccoons, by county, 2012

Reported cases of rabies involving skunks, by county, 2012

Raccoon $\rightarrow$ Skunk; Cross Species Transmission

- In NC, virtually all species (except bats) identified with rabies are infected with the raccoon variant
- Sustained transmission of the raccoon variant in other species is unlikely
  - Due to inherent phylogenetic barriers

Why the Return?

• Examine the History of Raccoon Rabies
  – natural transmission and spread
  – artificial transmission and spread
  – natural animal disease cycles
History of Raccoon Rabies

• 1936 - First record of rabid raccoon, California
• Average 47 cases/year through 1950’s
  – Assumed to be spillover cases from local endemic species
  – No raccoon to raccoon transmission documented
• 1947 - First record of rabid raccoon in Florida
  – Documented raccoon to raccoon transmission occurs
• Resulting epizootic extends into AL, GA and SC by late 1970’s
• Bats are thought to be the original source of the virus in raccoons...
  – The virus in raccoons is now adapted to that species
Progression of Raccoon Rabies in FL

History of Raccoon Rabies

• Raccoon rabies was introduced into West Virginia in 1977 by an apparent translocation of raccoons for hunting purposes

• A second epizootic began affecting WV, VA, MD, DE, NJ and PA and now extends to the Canadian border

• NC was perfectly, or unfortunately, situated directly between the two epizootics
Spread of Rabies in Mid Atlantic States, 1980-1988

Raccoon Rabies Distribution, US, 1988

The Real Problem with Raccoon Rabies

• Very efficient transmission among the reservoir species
  – Large numbers of rabid animals
• Associated public health cost
# Two States - Animal Rabies Cases

One With, One Without, Raccoon Rabies

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<td>NC</td>
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Public Health Cost of Raccoon Rabies

• Rabies post exposure prophylaxis is expensive
  – $1,000.00 - $4,500.00 per patient

• New Jersey PEP costs…
  – Before raccoon rabies: $1,100 per 100,000
  – After raccoon rabies: $74,734 per 100,000

Uhaa, et. al. Benefits and costs of using an orally absorbed vaccine to control rabies in raccoons. JAVMA. 1992, 201. 1873-82
Public Health Cost of Raccoon Rabies

• Massachusetts PEP administration…
  – Before raccoon rabies: 1.7 per 100,000
  – After raccoon rabies: 45 per 100,000

National ORV Program

• **Vision**
  – Eliminate rabies in terrestrial carnivores

• **Immediate Goals**
  – Prevent raccoon and grey fox strain of rabies virus from moving into new, uninfected areas
The Basis for ORV

- Produce a host that is resistant to an infection

- Odds of infective animal-susceptible animal interaction goes down with immunization of the population

- Critical mass – vaccinate enough animals and the further transmission of the virus may end