ASSESSMENT FOR A STATEWIDE RABIES VACCINATION REQUIREMENT FOR DOGS AND CATS IN KANSAS

By Chelsea (Stephens) Raybern
Kansas Department of Health and Environment (KDHE)

- Environment
- Health Care Finance
- Health
  - Bureau of Epidemiology and Public Health Informatics (BEPHI)
    - Infectious disease epidemiology and response
      - Disease investigations
      - Investigative reports
      - Statistics
BACKGROUND
Rabies

- Rabies is present on all continents except Antarctica
- Infects all species of mammals
- 55,000 human deaths annually
  - 95% in Africa and Asia
  - Rabid dogs responsible for 99% of deaths
  - 40% of people bitten are children <15-years-old
- 100% fatal, 100% preventable
History of Rabies

- Evidence came about in 23rd Century B.C.
- Large outbreak in 1271
- Reported in Americas in 1703
- Common in North America by 1785

Source: rabiesfree.org/page26.htm
The Virus

- Non-segmented negative strand of RNA genome
- Family: *Rhabdoviridae*
- Genus: *Lyssavirus*
- Encodes 5 proteins:
  - Nucleoprotein (N)
  - Phosphoprotein (P)
  - Matrix protein (M)
  - Glycoprotein (G)
  - Polymerase (L)
- Highly neurotropic
- Does not survive long in environment

Source: [cdc.gov/rabies/transmission/virus.html](https://cdc.gov/rabies/transmission/virus.html)
Distribution of Terrestrial Rabies Reservoirs in United States, 2009

Source: cdc.gov/rabies/exposure/animals/wildlife_reservoirs.html
Transmission

- Found in saliva or neural tissue of infected individual
- Bite exposure (COMMON)
- Non-bite exposures:
  - Open wounds, mucous membranes, transplants
- Incubation period:
  - Weeks-months, not symptomatic yet
- Multiplies in brain and causes fatal inflammation
  - Symptomatic
- Moves to salivary glands
  - Becomes transmissible
Diagnosis

- Kansas State University Rabies Laboratory

- Direct fluorescent antibody test (DFA)
  - Tissue from at least 2 areas of brain
    - Preferably brain stem and cerebellum

- Test between 1,800-2,500 animal specimens annually
Notification

- Suspect/confirmed cases are to be reported to Kansas Department of Health and Environment within 4 hours

- KSU Rabies Lab sends results to KDHE
  - KDHE notifies local health department of results
  - Health departments notifies veterinarian or submitter

- Quarantine of suspected rabid animals
  - Authority given to local health officer or their designee

- Centers for Disease Control and Prevention
  - Collects information about cases of animal and human rabies from state health departments
Rabies in Animals

- Any mammal can get rabies
- 7,000-10,000 cases/year in U.S.

Symptoms
- Initial signs
  - Restlessness
  - G.I. symptoms
- Encephalitic
  - Aggressive
- Paralytic
  - Progressive paralysis
  - Excessive salivation

Animal Rabies in U.S. – 2009

- 6,690 cases
  - Wildlife – 92.5%
    - Raccoons (2,327)
    - Bats (1,625)
    - Skunks (1,603)
    - Foxes (504)
  - Domestic animals – 7.5%
    - Cats (300)
    - Dogs (81)
    - Cattle (74)
    - Horses/Mules (41)

Animal Rabies in Kansas: 2006-2010

- 395 cases
  - Wildlife – 78.5%
    - Skunks (268)
    - Bats (35)
    - Raccoons (1)
    - Foxes (1)
  - Domestic animals – 21.5%
    - Cats (39)
    - Cattle (25)
    - Horses (10)
    - Dogs (9)

Rabies in Humans

- 31 cases in U.S. from 2000-2010
- Last reported case in KS was 1968

Symptoms

- Initial signs
  - Flu-like illness
- Encephalitic
  - Hyperactivity
  - Excited behavior
- Paralytic
  - Progressive paralysis
  - Coma

Source: balisurfstories.wordpress.com/2010/11/22/surfers-to-bali-beware-of-rabies/
Rabies Post-exposure Prophylaxis (PEP)

- 40,000 people receive PEP every year
- Costs: ~$3,000/person

Unvaccinated, healthy person
- Human rabies immunoglobulin (HRIG)
- Vaccine IM (4-dose on day 0, 3, 7, and 14)

Unvaccinated, immunocompromised person
- HRIG
- Vaccine IM (5-dose on day 0, 3, 7, 14, and 28)

Previously vaccinated person
- Vaccine IM only (2-dose on day 0 and 3)
Animal Vaccination

- Licensed rabies vaccines available
  - Dogs, cats, ferrets, horses, cattle, and sheep

- 40% of dogs and <20% of cats vaccinated

- Rabies Vaccination Laws
  - 38 states with law
  - Kansas not one of them

- Cornerstone of rabies prevention
  - Vaccination programs have eliminated canine variant in U.S.

Source: epi.publichealth.nc.gov/vet.html
Objective

To determine the effectiveness of countywide rabies vaccination laws to prevent cases of rabies among dogs and cats in Kansas
Questions

- What are the vaccination rates and rabies incidence of pet domestic animals in Kansas?

- Does a county rabies vaccination law affect rabies vaccination status and rabies incidence in dogs and cats in Kansas?

- Does residing within city limits affect vaccination rates and rabies incidence in dogs and cats in Kansas?
METHODS
Animal Rabies Vaccination Survey

- Multiple choice and free text portion

- 27 questions regarding county-level information

- Main objective was to determine which counties have a rabies vaccination law

- Sent to all county health departments in Kansas
Rabies Test Data

- Collected through submission form
  - http://www.vet.k-state.edu/depts/dmp/service/rabies/diagnostic.htm

- Obtained for all dogs, cats, and ferrets from Kansas State University Rabies Laboratory (2006-2010)
Statistical Analysis

- Calculated difference between two independent proportions

- Significance of difference was determined
  - 95% CI
  - Hypothesis test
Calculations for Analysis

- **Difference in proportions:** $(p_1 - p_2)$

- **95% CI:**
  - $(p_1 - p_2) \pm 1.96 \text{SE}$
  - where $\text{SE} = \sqrt{\frac{p_1 (1 - p_1)}{n_1} + \frac{p_2 (1 - p_2)}{n_2}}$

- **Hypothesis test:**
  - Pooled sample proportion: $p = \frac{p_1 n_1 + p_2 n_2}{n_1 + n_2}$
  - Standard error: $\text{SE} = \sqrt{p (1 - p) \left[ \frac{1}{n_1} + \frac{1}{n_2} \right]}$
  - Test statistic: $z = \frac{p_1 - p_2}{\text{SE}}$
  - P-value
RESULTS
What are the vaccination rates and rabies incidence in pet domestic animals in Kansas?
All Submitted Rabies Tests

KSU Submission Records
3,785
All Submitted Rabies Tests

Out of State Submissions
27

KSU Submission Records
3,785

In State Submissions
3,758
### Test Results of Dogs, Cats, and Ferrets, 2006-2010

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<td>6 (100%)</td>
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<td>8 (0.5%)</td>
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All Submitted Rabies Tests

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- Unknown Vaccination Status: 1,816
- Vaccination Status: 1,942
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<td><strong>Out-of-Date</strong></td>
<td>262 (59.3%)</td>
<td>180 (40.7%)</td>
<td>0 (0%)</td>
<td>442</td>
</tr>
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<td><strong>Not</strong></td>
<td>288 (31.8%)</td>
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Does a county rabies vaccination law affect rabies vaccination status and rabies incidence in dogs and cats in Kansas?
Animal Rabies Vaccination Survey

County Health Departments
105
Animal Rabies Vaccination Survey

County Health Departments
105

No Response
4

Completed Survey
101
Animal Rabies Vaccination Survey

County Health Departments
105

No Response
4

Completed Survey
101

Law
23

No Law
56

Did Not Know
22
Animal Rabies Vaccination Survey

County Health Departments
105

Followed Up With Phone Call

No Response
4

Completed Survey
101

Followed Up With Phone Call

Law
23

No Law
56

Did Not Know
22
Animal Rabies Vaccination Survey

County Health Departments
105

Completed Survey
101

Law
23

No Law
56

Did Not Know
22

No Response
4

Law
21

No Law
23

No Law
2

Unknown
3

Law
1

No Law
18
Animal Rabies Vaccination Survey

- No Rabies Vaccination Law: 80 (76.2%)
- Don't Know: 3 (2.8%)
Animal Rabies Vaccination Survey

- No Rabies Vaccination Law: 80 (76.2%)
- Vaccination Law: 22 (21%)
- Don't Know: 3 (2.8%)
Animal Rabies Vaccination Survey

No Rabies Vaccination Law 80 (76.2%)

Vaccination Law 22 (21%)

Don't Know 3 (2.8%)

Dogs 10 (45.5%)

Dogs and Cats 8 (36.4%)

Dogs, Cats, Ferrets, and Horses 1 (4.5%)
All Submitted Rabies Tests

Out of State
27

In State Submissions
3,758

KSU Submission Records
3,785
Rabies Tests Submitted from Counties with Vaccination Law Status

Inclusion Criteria:

- Dog or cat
- Resided in a county with a known rabies vaccination law status

KSU Submission Records: 3,785

In State Submissions: 3,758

Out of State: 27

Excluded: 72

Met Inclusion Criteria: 3,686

Dogs: 1,669

Cats: 2,017
Test Results of Dogs Submitted from Counties with a Known Vaccination Law Status, 2006-2010

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<td>19 (2%)</td>
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<tr>
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<td>10 (1%)</td>
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Rabies Tests Submitted from Counties with Vaccination Law Status

- **KSU Submission Records**: 3,785
  - **In State Submissions**: 3,758
    - **Met Inclusion Criteria**: 3,686
    - **Excluded**: 72
  - **Out of State**: 27
Rabies Tests Submitted from Counties with Vaccination Law Status

Out of State
27

Excluded
72

Unknown Vaccination Status
1,785

In State Submissions
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Vaccination Status
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KSU Submission Records
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Dogs
980

Cats
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All Submitted Rabies Tests

- Out of State
  - 27

- In State Submissions
  - 3,758

- KSU Submission Records
  - 3,785
Geocoded Rabies Tests

- Inclusion Criteria:
  - Dog or cat with a positive or negative test result
  - Had a valid physical address and resided in county with known law status

In State Submissions
- 3,758
  - Excluded
    - 2,169
  - Met Inclusion Criteria
    - 1,589

Out of State
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- Dogs
  - 734

- Cats
  - 855
Test Results and Area of Residence for Dogs, 2006-2010

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<tbody>
<tr>
<td>Negative</td>
<td>543 (99.5%)</td>
<td>184 (97.9%)</td>
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<tr>
<td>Positive</td>
<td>3 (0.5%)</td>
<td>4 (2.1%)</td>
<td>0.016</td>
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<td>Total</td>
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<td><strong>Positive</strong></td>
<td><strong>3 (0.5%)</strong></td>
<td><strong>4 (2.1%)</strong></td>
<td><strong>0.016</strong></td>
<td>-0.006, 0.038</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>546</td>
<td>188</td>
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## Test Results and Area of Residence for Cats, 2006-2010

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<tr>
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<td>551 (98.2%)</td>
<td>275 (93.5%)</td>
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Geocoded Rabies Tests

- KSU Submission Records: 3,785
- Met Inclusion Criteria: 1,589
- In State Submissions: 3,758
- Out of State: 27
- Excluded: 2,169
Geocoded Rabies Tests

- KSU Submission Records: 3,785
  - Out of State: 27
  - Excluded: 2,169
  - Unknown Vaccination Status: 751
  - Met Inclusion Criteria: 1,589
    - Vaccination Status: 838
      - Dogs: 440
      - Cats: 398

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<td>156 (50.8%)</td>
<td>33 (24.8%)</td>
<td>0.26</td>
<td>0.168, 0.352</td>
</tr>
<tr>
<td><strong>Out-of-Date</strong></td>
<td>84 (27.4%)</td>
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Conclusions

- Higher vaccination rates in dogs
- More vaccinated dogs and more positive dogs* from counties with vaccination law for dogs
- More vaccinated cats and fewer positive cats from counties with vaccination law for cats
- More vaccinated dogs and fewer positive dogs* residing inside city limits
- More vaccinated cats* and fewer positive cats residing inside city limits

*Difference in proportions was not statistically significant
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Limitations

- Animal Rabies Vaccination Survey
  - Knowledge of laws by person answering the survey
    - Many people unsure if county had a law
    - Answered in reference to city
    - Validity of responses are unknown
Limitations

- Rabies Test Data
  - Incomplete data fields
    - 47% of physical address left blank
    - Limited sample size
  - Location of animal
    - 7% listed vet office/shelter as address
    - No guarantee of listed address (owned/stray)
Limitations

- Rabies Test Data
  - Source of data to obtain vaccination rates
    - Animal suspected to have rabies submitted
    - Vaccination rates may be lower in this population
  - Rabies surveillance data not uniform
    - Some counties very seldom or never submit animals
Discussion

- Reasons cat vaccination rates are so low
  - Vaccination law specifications
    - 30 of 38 state laws pertain to cats
    - 12 of 22 KS county laws pertain to cats
  - Feral cat population
    - Suspected to approach population of owned cats (90.5 million in 2006)
  - Defining the term ‘pet ownership’
    - Feed feral and stray cats
    - Allow them to seek shelter on their property
Results suggest number of rabies-positive dogs and cats can be decreased in Kansas by enacting a statewide mandatory rabies vaccination law for dogs and cats.

Mandated vaccination programs of domestic animals have shown to be effective in rabies prevention.

• CDC study
  ○ Found that rabid cats less likely to be found in counties with states that have rabies vaccination law than in counties with states with no such law.
Recommendations

- Further analysis needed
  - Examine additional risk factors for why people do not vaccinate their animals
  - Rural counties VS urban counties
  - Events/trials logistic regression model

- Research to compare prevalence of rabies in dogs and cats in states with a law to states with no law
Recommendations

- Local health departments and county officials
  - Refresh on rabies vaccination laws to better inform their local communities

- Veterinarians
  - Made aware the importance of completing rabies submission form

- KSU Rabies Lab
  - Follow-up with submitter if missing information
  - Standardize categories within data

- Statewide rabies vaccination requirement for all dogs and cats
Acknowledgements

We would like to thank:

- Kansas local health departments and county agencies for participation in survey

- Nolita LaVoie, GISP, of KDHE for geocoding rabies data and creating map

- Cathleen Hanlon, VMD, PhD, Dipl ACVPM; Mike Moore, DVM; and Rolan Davis, MS, of KSU Rabies Lab for providing rabies data
References

References

Questions?

chelsea4@ksu.edu