One Health Approach to Rabies Control

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Rabies background

• Oldest infectious disease known to mankind - first record appearing in the Laws of Eshunna in 23rd century BC

• Zoonotic nature noted early in history

• Virus spreads through bites, licks and scratches from infected animals by direct contact

• Transmitted by saliva of rabid animal
Rabies Global burden and Impact

99.9% fatal after clinical signs

≥ 59,000 human deaths per year

40% are children under the age of 15

63% live in Asia

36% live in Africa

100% preventable!
Global distribution and reservoirs

Dog mediated rabies

Wild life transmitted rabies
Rabies in the United States

~ 5,000 animal rabies cases reported to CDC every year (90% wildlife)

Annual expenditure for rabies prevention in United States > US$300 million

55,000 people administered PEP every year
Average cost PEP = $3800 USD

More information on rabies by US State: http://rabiesaware.org/
Animal rabies in the United States

Mass vaccination of dogs against rabies started (1947)

No. of domestic animal cases


Year

0 20 40 60

No. of human cases


US National Rabies Surveillance System

Pieracci. et al. (2019)
Animal rabies in the United States


Primary animal reservoirs for rabies in the US

Ma et al, 2020
Rabies cases in the United States - 2021

- 3,252 animals reported rabid
- 91.5% wildlife
  - Bats 33.9%
  - Raccoons 28.1%
  - Skunks 18.9%
  - Foxes 8.6%
- Cats - most common rabid domestic animal
- Five humans

Ma et al, 2023
KSVDL tested positive in 2021
(by Species, County and Kansas Region)
Diagnosis of rabies in animals

• Conducted using the national standard protocol - Direct Fluorescent Antibody (DFA) test

• Use of brain tissue (brain stem, cerebellum, hippocampus) - performed post-mortem

• Brain impression smears fixed and stained with antibody conjugates. Incubate and wash off excess stain.
Diagnosis of rabies in animals

• Mount and examine slide with a fluorescence microscope for viral antigen – seen as apple green fluorescence

• Result categories:
  • Positive
  • Negative
  • Unsuitable
  • Indeterminate

• Report to KDHE

Microscopic examination of stained brain impression slides for rabies diagnosis at KSU Rabies Lab
Rabies testing: total samples and positives (2008-2023)
Rabies positive species – most common diagnosed
Rabies surveillance

• Monitor spatiotemporal and demographic occurrence of cases

• Inform and facilitate rabies prevention and control measures
  • PEP decisions and animal exposure risk assessments
  • Political and financial commitment

• Fulfill international and national reporting requirements
Rabies surveillance in the US

- National Rabies Surveillance System (NRSS) - laboratory based surveillance system with about 130 laboratories that conduct animal rabies testing

- USDA Wildlife Services monitors select areas of the country for wildlife rabies

- Human and animal rabies are national notifiable conditions
The epidemiological evolution of rabies

• Shift in reservoirs from domestic dogs to wildlife

• Human interaction with environment - more relevant to prevention measures

• Anthropogenic changes increase risk of spill over from wildlife
Rabies investigation

1. Identify if there was a human or animal exposure

2. Assess the risk of rabies transmission

3. Decide how to manage the exposed/exposing animal

4. Make recommendations on rabies post-exposure prophylaxis
Risk assessment for rabies transmission

- Species of biting animal
- Circumstances of exposure
- Geographic location of exposure
- Behavior and health status of biting animal
- Site and extent of exposure
- Vaccination history
Risk assessment for rabies transmission

- Species likely to be infected varies by location
- Bat contact considered more risky
- Provoked vs unprovoked exposures
- Exposure considered if it cannot be definitely ruled out in a situation:
  - Unconscious person-sleeping/intoxicated
  - Unattended child or mentally disabled person

Rabies animal reservoirs and species at higher risk of infection varies by place and time

Bat bites are very small
Normal vs abnormal behavior
Risk assessment for rabies transmission

- Probability that animal is rabid based on local disease situation

- Health and availability of animal for examination and testing

- Type of exposure (e.g. scratch vs bite, multiple vs single) and location of wound on body
Postexposure management in animals

Exposed to a confirmed or suspected rabid animal

Management depends on several factors:
• Species of exposed animal
• Vaccination status of exposed animal
• Time since exposure
• Ability to confine animal for observation
Kansas Rabies Legislation

**Rabies control requirements** Kan. Admin. Regs. § 28-1-13
(a) Isolation of the mammal causing an exposure
(b) Quarantine of mammals exposed to rabies

“(a) The possession or sale of skunks, raccoons, foxes and coyotes for keeping of these mammals as pets shall be prohibited.
(b) Removal of musk glands of skunks for purposes of attempted domestication shall be prohibited.
(c) Except as permitted by the secretary, attempts to immunize skunks, coyotes, raccoons, foxes, and other wildlife mammals known to be involved in the transmission of rabies shall be prohibited.
(d) Subsections (a) and (b) of this regulation shall not apply to bonafide zoological parks or research institutions.”
Animal rabies vaccination

- **No State-level requirement for rabies vaccination** in Kansas but cities or counties may have rabies vaccination ordinances or resolutions

Source: https://www.avma.org

More information on rabies by US State: http://rabiesaware.org/  
https://www.animallaw.info/content/rabies-vaccination-and-exemption-laws-dogs
Animal rabies vaccination

- Other States where rabies vaccination is a **State-level requirement exemptions** may be allowed under certain circumstances e.g. Colorado

Colorado Revised Statutes Title 25. Health § 25-4-607. Order of board of health requiring inoculation of animals

(2) A veterinarian, with the written consent of an animal's owner, may issue a written waiver pursuant to the rules of the health department, exempting an animal from a rabies vaccination order if the veterinarian, in his or her professional opinion, determines that the rabies inoculation is contraindicated due to the animal's medical condition.

(3)(a) The executive director of the health department shall enact rules allowing for the exemption of an animal from a rabies vaccination due to the medical condition of the animal.

(b) The owner of an animal seeking an exemption from a rabies vaccination for his or her animal must provide the veterinarian with written consent for the exemption.
Postexposure management in humans

1. Wound care

2. Risk assessment for rabies transmission and need for PEP

3. Post exposure prophylaxis (PEP) administration

Prophylaxis can be given and effective up until signs and symptoms appear
Human rabies in the United States

• Human rabies is rare with an average of 1-3 cases per year
  • Bats responsible for 70% of cases

• 5 human rabies deaths in the United States during 2021
  • 4 occurred after **direct contact with bats**
  • 3 cases PEP was not sought

• The most common reason that patients did not receive PEP was not knowing that bats can transmit rabies
Education and awareness

• Syndromic surveillance data used to examine rabies post exposure prophylaxis in 2017

• Lack of awareness about risk of bats addressed by implementation of a **communication campaign** to education residents and healthcare providers

• Components of campaign:
  • Radio outreach to public
  • Social media outreach to public
  • Quarterly newsletter for medical providers

• **Outcome**: increased reporting by public and increased technical assistance to health care providers on PEP recommendations
What is One Health?
One Health definition and application

One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.

The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development.
One Health economics – timing of intervention

- Rabies circulating in dog population
- Public health intervention
- Clinical disease without PEP
- Post exposure prophylaxis (PEP)
- $$$
- $$$$
One Health economics

• Cost of human PEP treatment far outweighs the cost to vaccinate dogs

• The price of rabies immunoglobulin (RIG) has increased by nearly 400% over 10 years (2007-2017)

• Medical care and other related costs increase overall economic burden
One Health economics

- Kansas, Feb 2019: dog imported from Egypt confirmed rabid
- Public Health Response: KDHE, KDA, Johnson County DoHE, Missouri DoHSS, MDA, USDA and CDC
- PEP administered to 44 persons - ~ $9,290/person
- Response to each imported case ~$214,000 in personnel time
- Import control regulatory review conducted with updates being implemented
Rabies control in the United States

• Vaccination of animals to limit endemic circulation in wild animals and prevent spill over

• Surveillance and laboratory testing

• Prevent disease development in humans after exposures by use of biologics

• Improved biologics for prevention and treatment
Key elements to facilitate cross-sectoral collaboration

- Political will
- Trust between partners
- Standards and legislation
- Common objectives
- Shared benefits
- Routine communication
- Coordinated planning
- Active cooperation
- Capacity building / strengthening
- Resources
Joint rabies advocacy

• World Rabies Day 2023: theme “All for One and One Health for All”

• Poster competition – educate children about wildlife rabies reservoirs risks to humans and pets and highlight the ways transmission can be prevented

• Judging panel comprised representatives from veterinary, public health, environmental, NGO, industry partners

• 297 entries from 30 schools across 23 counties - winners in 4 age categories

1st place Winner: 2nd grade, Bluemont Elementary
Capacity building beyond rabies

- Strengthen Health Care Systems
- Build trust with the community
- Reinforce laboratory capacity
- Strengthen collaboration between human and animal health sectors for a One Health approach

https://openwho.org/courses/NTDs-Rabies-and-one-health/
Thank you!