4-17-2020

College of Natural Sciences, Forestry, and Agriculture_AVS 249_Laboratory and Companion Animal Science Slides

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Infectious diseases and zoonoses of companion animals

Lecture Learning Objectives

- **Describe common infectious diseases in cats and dogs**
- **Explain how these diseases be prevented and managed**
- **Define the term zoonoses and explain their significance to veterinary and public health**
- **Describe the roles of pets and lab animals in zoonotic disease transmission**

Infectious Agents

Bacterium

Virus

Fungus

Protozoan

Helminth

Prion

Infection vs. disease?

Infection: Microbe enters body and multiplies

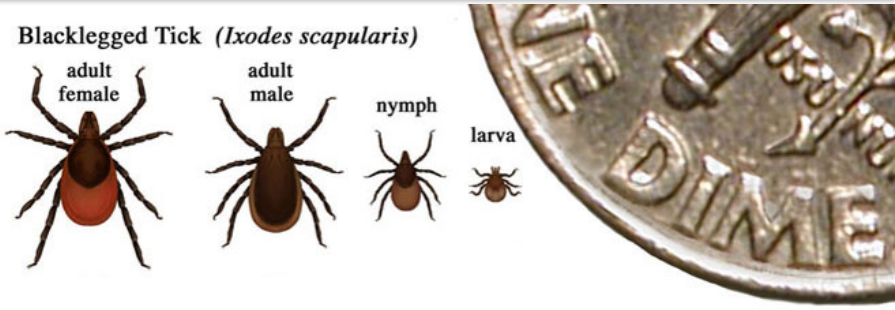
Pathogen: infectious agent causing disease

Disease: Cells damaged, signs of illness appear

Pathogenesis: manner of disease development

Infectious Diseases of Cats and Dogs

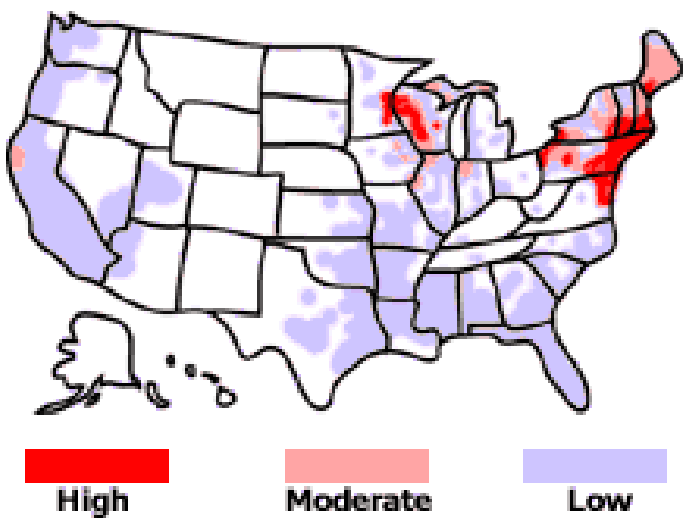
Bacterial Diseases



Borreliosis (Lyme disease)

- Bacteria, *Borrelia burgdorferi*
- Transmitted by ticks, genus Ixodes
- *Signs*: lameness, swelling of joints, depression, fever, lack of appetite
- Blood tests used to detect antibodies
- Treatment: antibiotics
- Vaccines - effectiveness controversial
- Prevention: tick control

Incidence of borreliosis in dogs



Viral Diseases

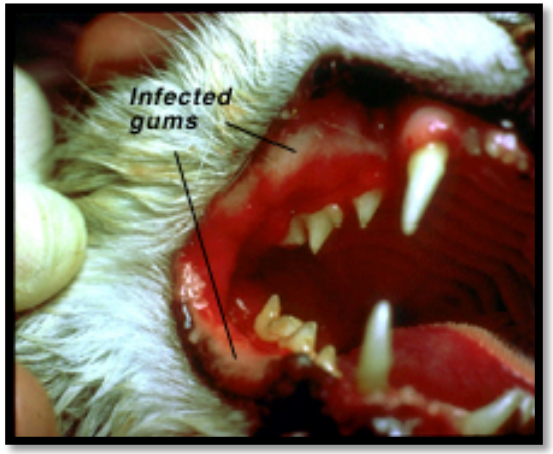
Canine distemper

- Transmission: inhalation of viral particles, shed in secretions
- Impacts several body systems
- Immunosuppression → secondary infections
- *Signs*: variable, depend on dog's immune status
  - Fever
  - Eye/nasal discharge
  - Labored breathing/coughing
  - Hardened nose/ foot pads
- *Diagnosis*: antibodies in epithelial cells, cerebral spinal fluid
- *Treatment*: supportive care
- Vaccines effective

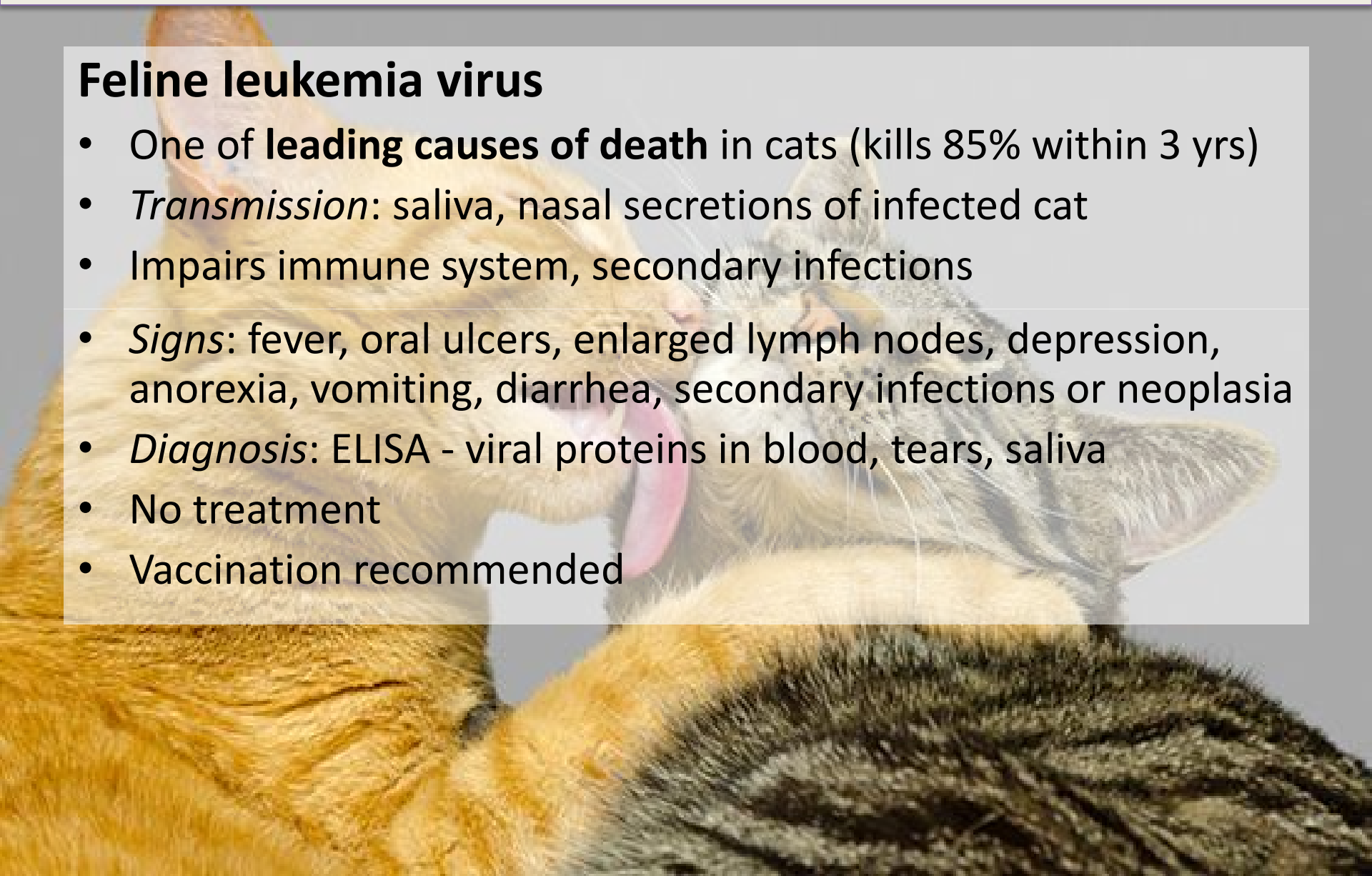
Viral Diseases

Feline immunodeficiency virus

- 1.5-3% cats infected
- *Transmission*: bite by infected cat, shed in saliva
- May be asymptomatic for months to years
- Develop secondary infections: fever, weight loss, coughing, oral ulcers, diarrhea
- *Diagnosis*: FIV antibodies in serum
- Keep FIV-infected cat indoors
- Vaccine – unknown effectiveness



Viral Diseases

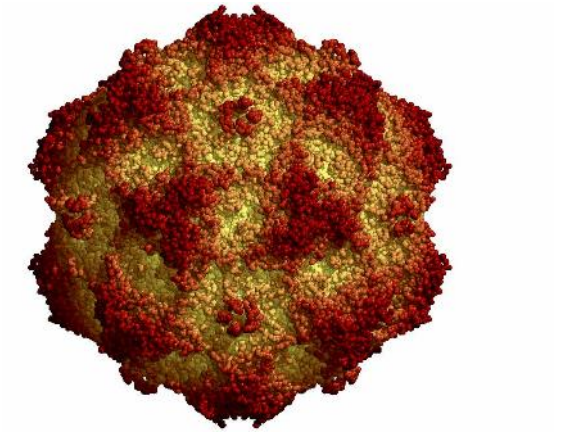


Feline leukemia virus

- One of **leading causes of death** in cats (kills 85% within 3 yrs)
- *Transmission*: saliva, nasal secretions of infected cat
- Impairs immune system, secondary infections
- *Signs*: fever, oral ulcers, enlarged lymph nodes, depression, anorexia, vomiting, diarrhea, secondary infections or neoplasia
- *Diagnosis*: ELISA - viral proteins in blood, tears, saliva
- No treatment
- Vaccination recommended

Viral Diseases

Canine parvovirus



- Usually affects puppies (<1 yr)
- Attacks dog's GI tract
- Can infect heart = sudden death
- *Signs*: Severe vomiting, bloody diarrhea
- *Transmission*: oral contact with infected feces
- *More susceptible breeds*: Rottweiler, Doberman Pinscher, German Shepherd
- *Vaccines*: not 100% effective

Feline panleukopenia virus

- Closely related to canine parvovirus
- No transmission between species

Fungal Diseases

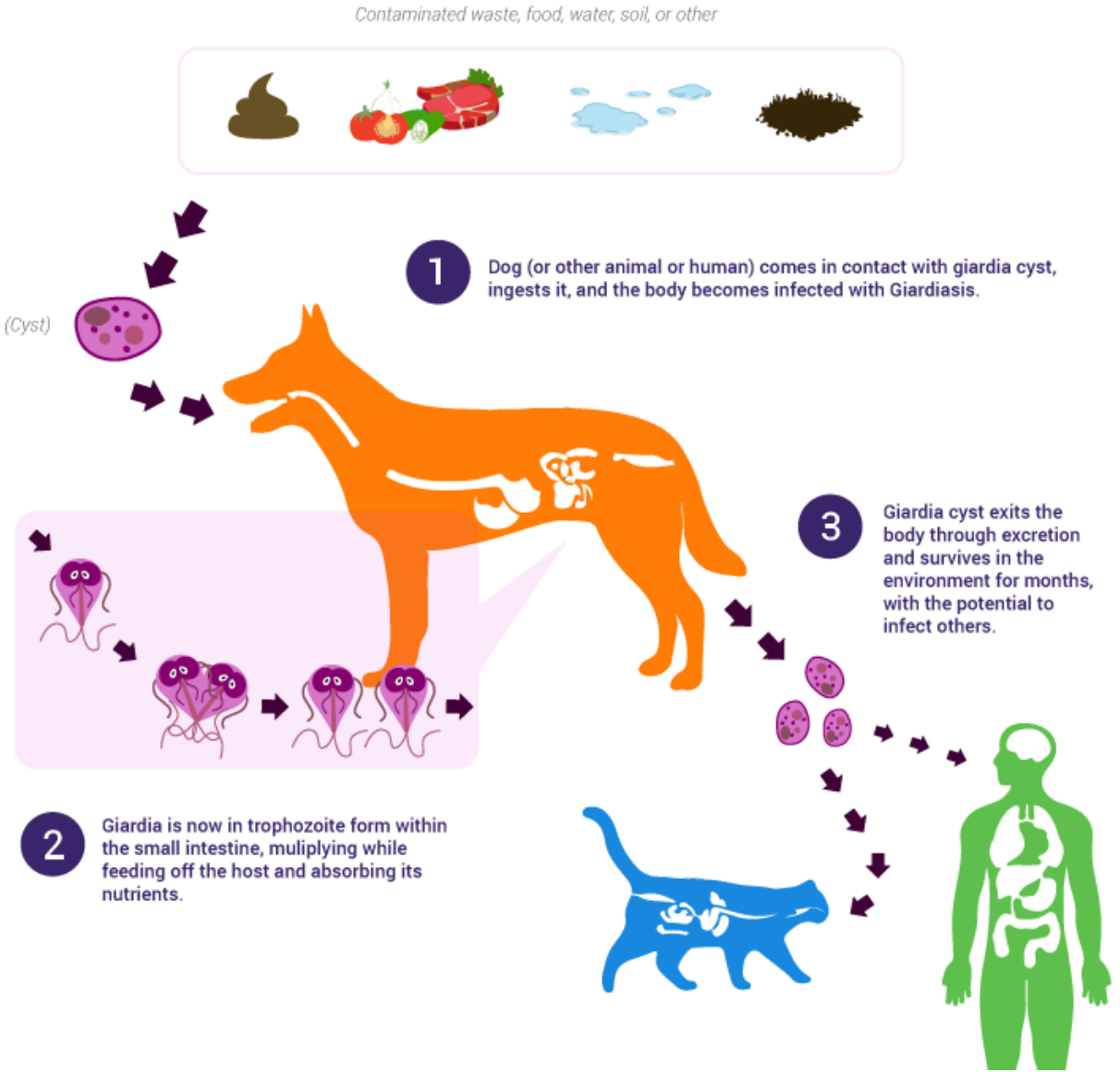
Ringworm

- Fungi, in keratinized tissues (skin, hair, claws)
- Persist for long time
- Infects many mammalian species (zoonotic)
- *Signs*: hair loss, deformed claws
- *Diagnosis*: culture
- *Treatment*: antifungal medications

Protozoan Diseases

Giardiasis

- Transmission: feces, contaminated food, water
- Zoonotic
- No effective vaccine
- Common signs: loose stool, weight loss, vomiting



Kennel Cough in Dogs

- **Tracheobronchitis**: Upper respiratory infection
- Multifactorial infection, can involve both bacteria and virus
- Most common bacterial agent: *Bordetella*
- Possible viral contributor: canine parainfluenza virus, adenovirus
- *Signs*: honking cough, low grade fever
- *Treatment*: antibiotics, but depends on agent

Upper Respiratory Infection in Cats

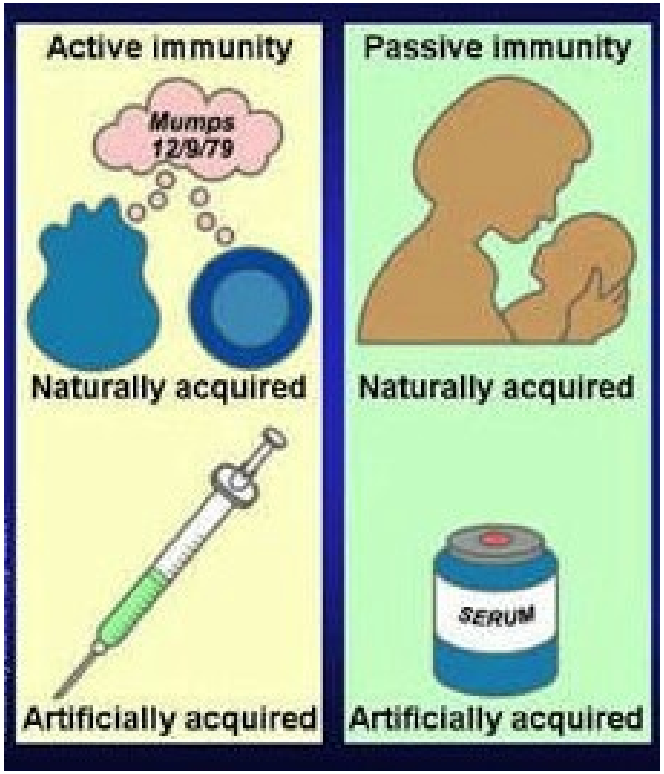
- Kennel cough can be transmitted to cats
- Most common bacterial agent: *Bordetella*
- Most common viral agents: Feline viral rhinotracheitis (FVR), feline calicivirus
- Chronic carriers of FVR – symptoms reemerge with stress
- *Signs:* sneezing, cough, congestion, runny nose, eye discharge

Feline viral rhinotracheitis

Types of Immunity

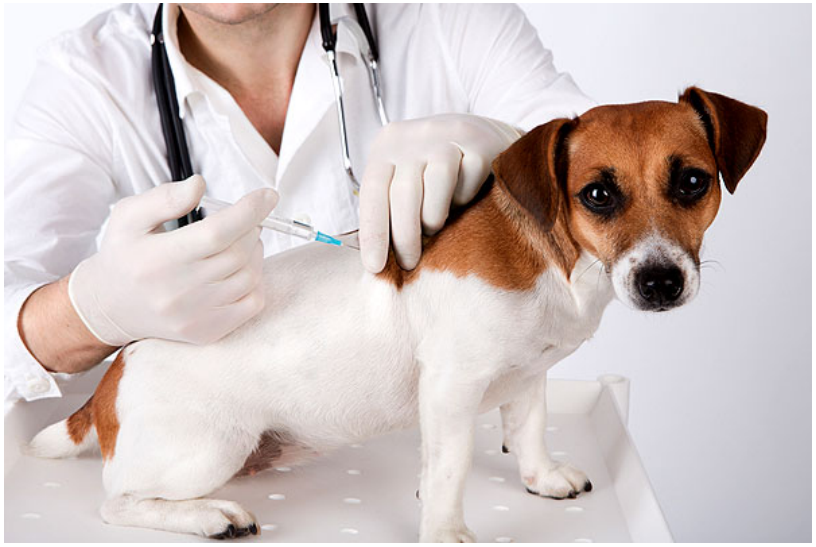
Immunity: capacity to resist infection against a specific disease

- *Natural immunity*: due to species differences in susceptibility
- *Passive immunity*: transfer of antibodies formed in one animal to another
- *Active immunity:* animal exposed to a foreign antigen and responds by producing antibodies against antigen



Vaccination

- Stimulates immune system to prevent specific agent infections
- Made of agents rendered noninfectious but capable of inducing an immune response
- No vaccine is always 100% effective
- Vaccination greatly reduces incidence/severity of most infections



- **Killed vaccines**: Dead or inactivated pathogens (e.g., rabies, leukemia)
- **Modified live vaccines (MLV)**: Weakened or attenuated form of the pathogen (e.g., Canine distemper, parvo)

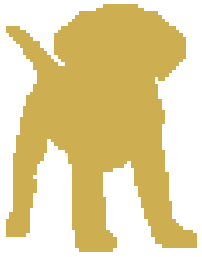
Recommended Core Vaccines for Dogs and Cats

CAT

Feline viral rhinotracheitis
Calcivirus
Panleukopenia (distemper)

(FVRCP)

DOG



Distemper
Adenovirus-2
Parvovirus
Parainfluenza
Leptospirosis

(DA2PP)

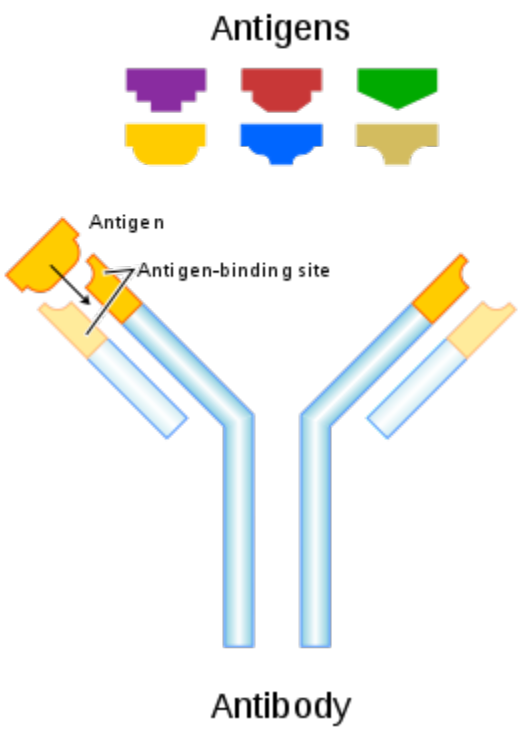
Rabies – required by law!

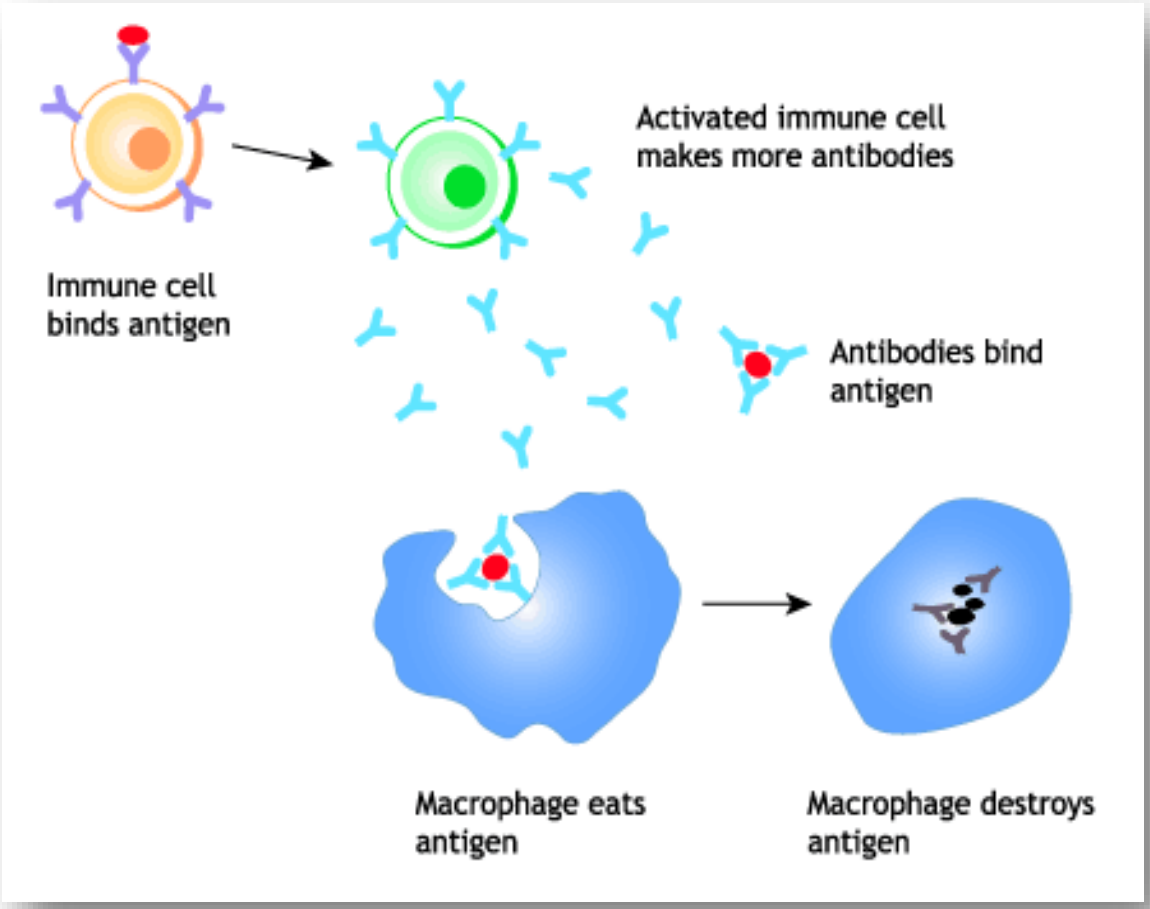
Vaccination Failures and Adverse Reactions

- ***Vaccination failure***: failure to induce protective immunity
  - Can be vaccine- or host- related
  - Common cause: in young animal, maternal antibodies providing passive immunity inactivates MLV agents

- ***Allergic reactions***: vomiting and diarrhea or itching, hives, facial swelling, respiratory distress, cardiovascular collapse, death
  - May develop within 10 -15 minutes following vaccination

What does antibody testing tell us?

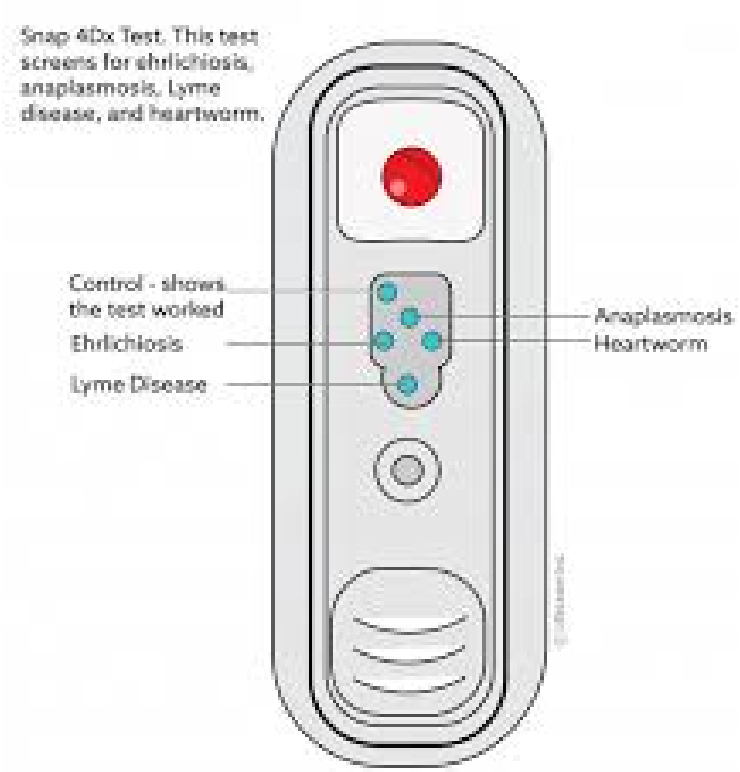




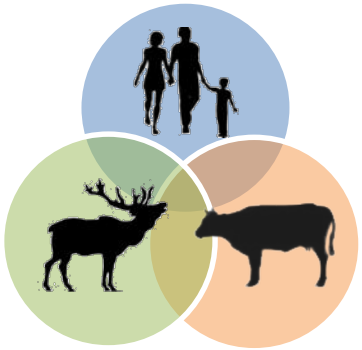
IDEXX SNAP Tests

E.g., Feline Triple Test: FIV, FeLV, Heartworm

- ELISA: Enzyme-linked immunosorbent assay
- Serological test to detect exposure to pathogens

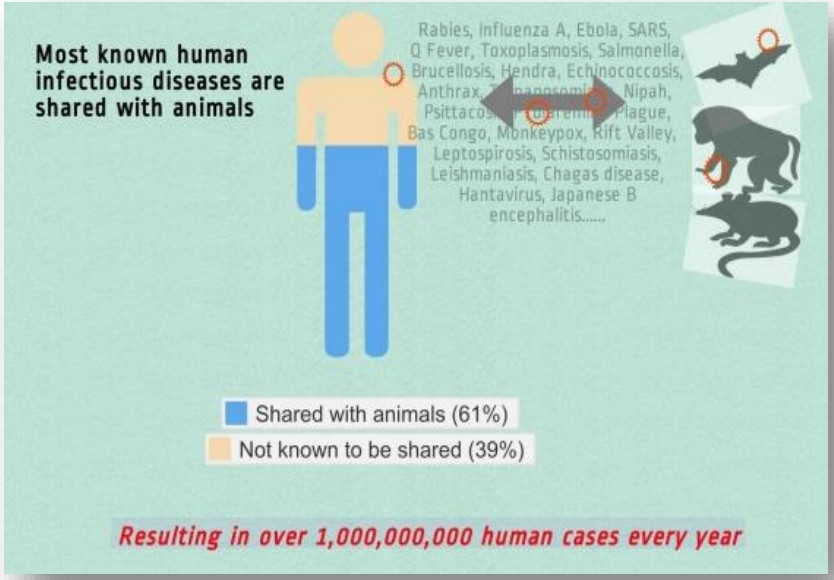


Zoonoses



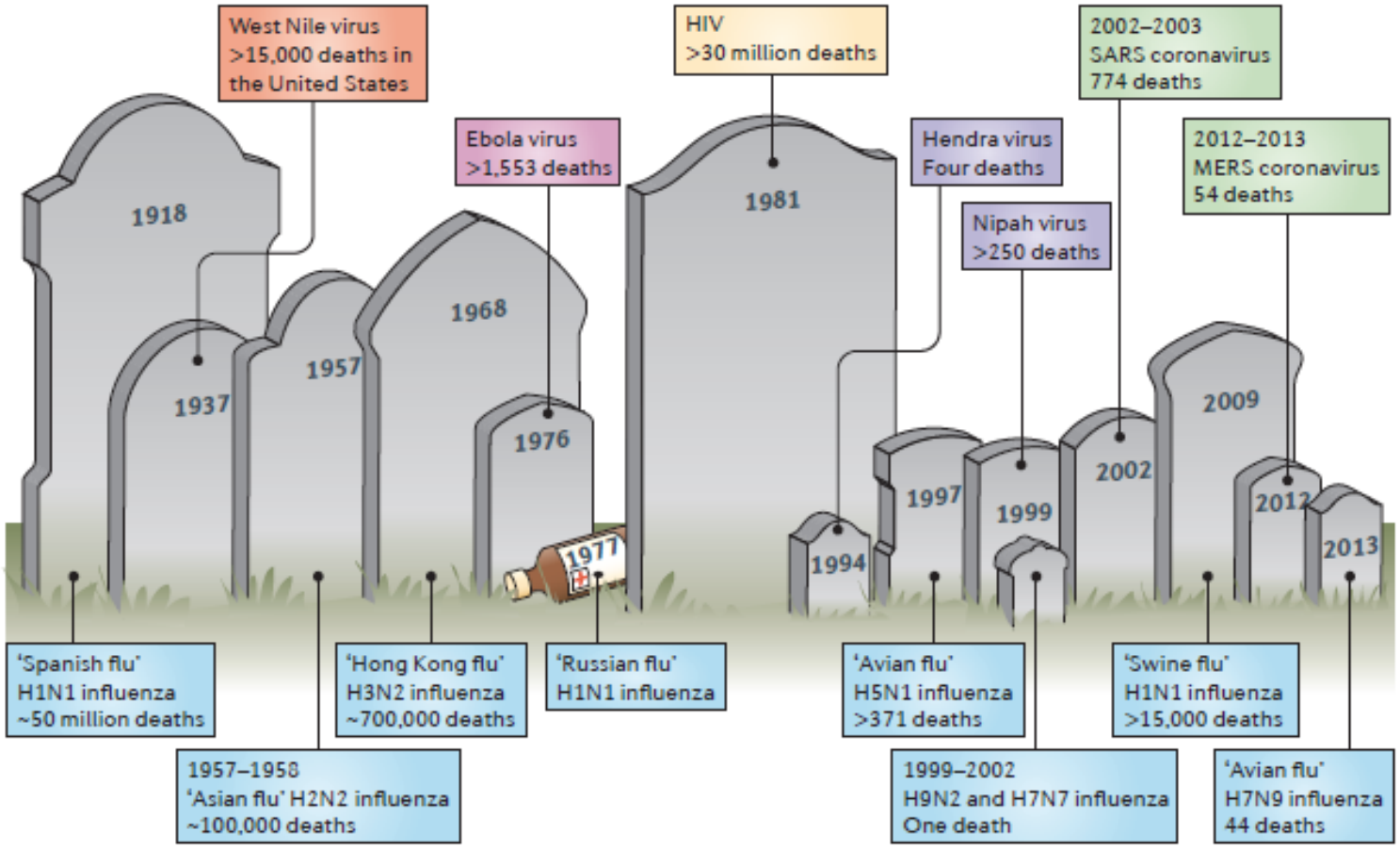
What are zoonoses?

- **Zoonosis**: Infectious disease transmitted from animals to humans
- ~60% of human diseases and 75% of emerging infectious diseases have zoonotic origin
- Major public health problems caused by 'old' zoonoses (e.g., HIV, malaria)



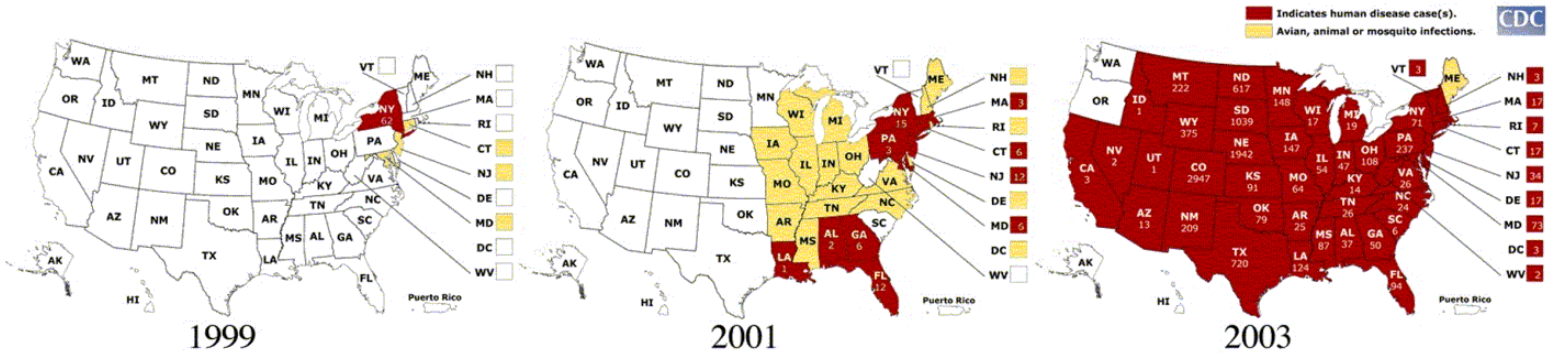
From: Machalaba and Karesh (EcoHealth Alliance)

Historical consequences of emerging zoonoses



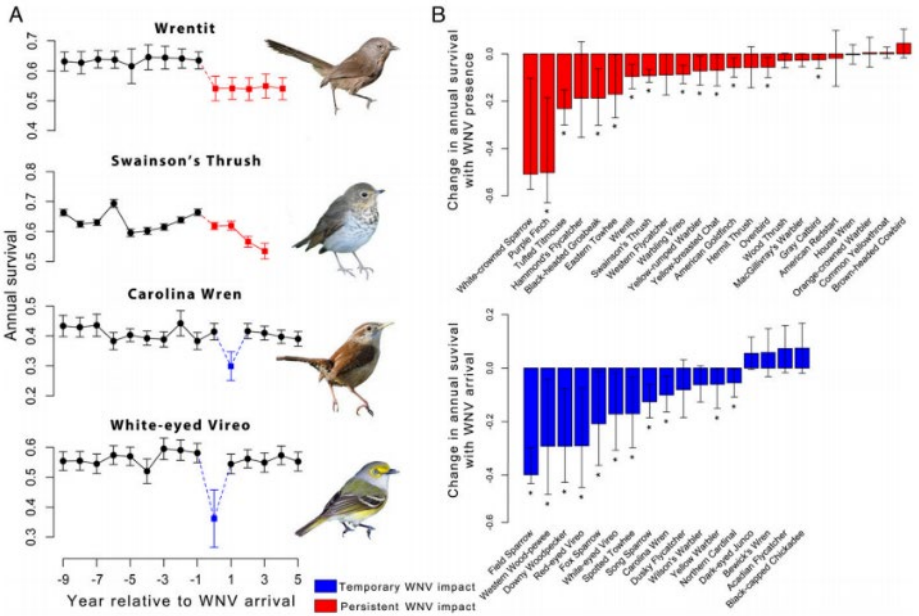
Bean et al. 2013

Spread of West Nile Virus in the United States



- First case in NYC in 1999
- Rapid spread by avian hosts across the United States
- Vector: Culex mosquito
- Primarily affects humans, birds, horses

Negative effects in 47% of birds

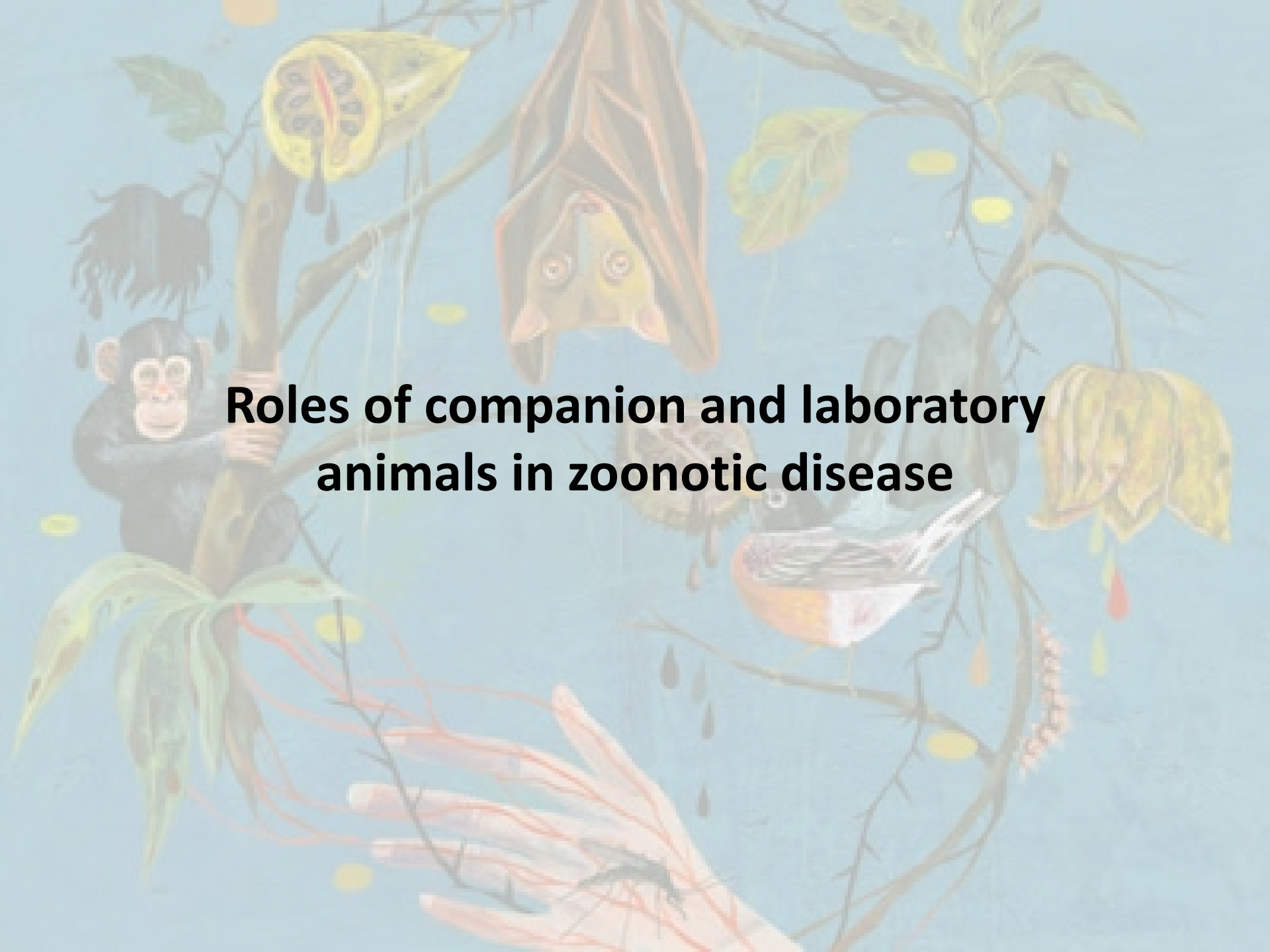


George et al. 2015, PNAS

Drivers of increasing disease emergence

- Increasing human population
- Globalization: international travel, pet and bushmeat trade
- Climate change: shifting distributions of hosts and vectors
- Changes in land use
- Breakdown of public health measures
- Antimicrobial use

From: Machalaba and Karesh (EcoHealth Alliance)



Roles of companion and laboratory animals in zoonotic disease

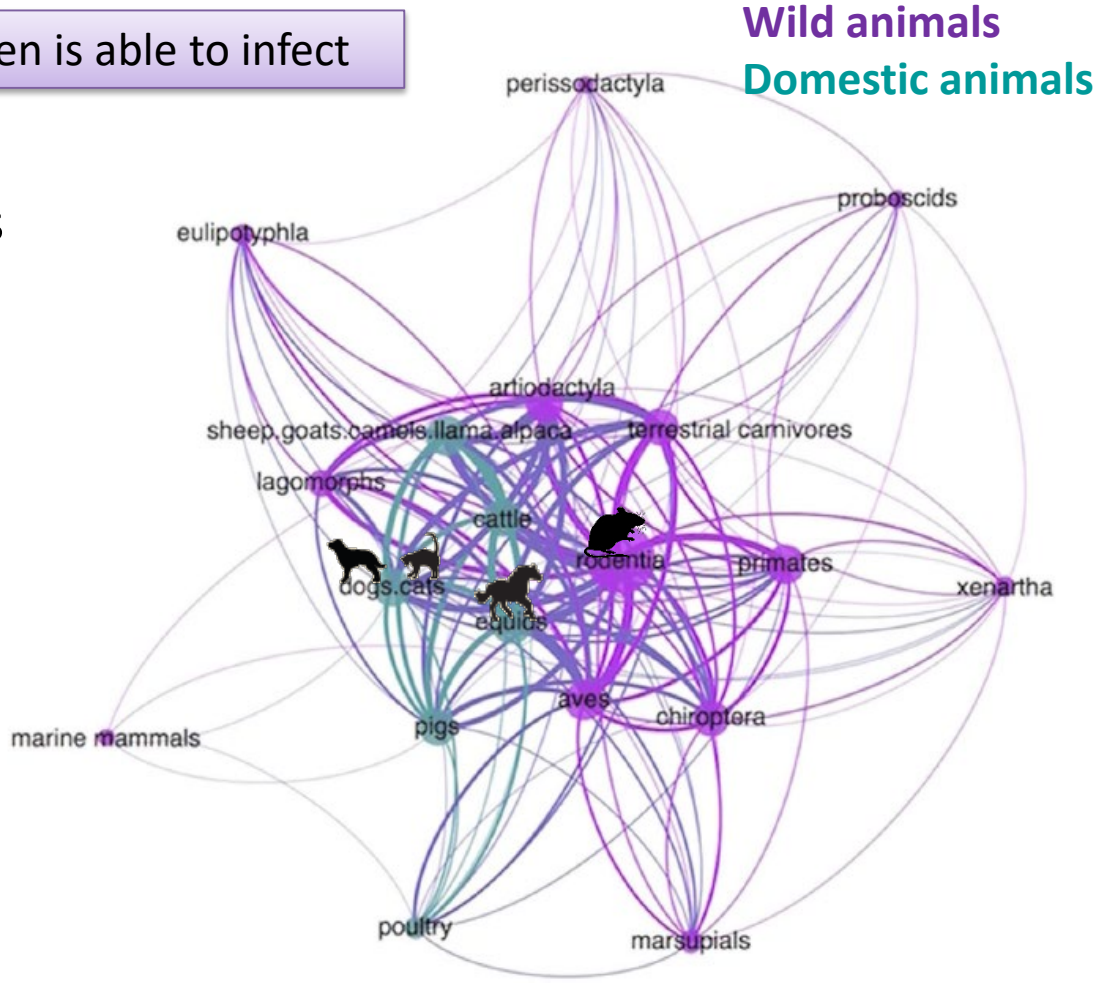
68% of U.S. households (~85 million) own a pet

Source: Animal Pet Products Association, 2017-2018 Survey

Domestic animals play a key role in the epidemiology of viral zoonotic diseases

Host range: # of hosts a pathogen is able to infect

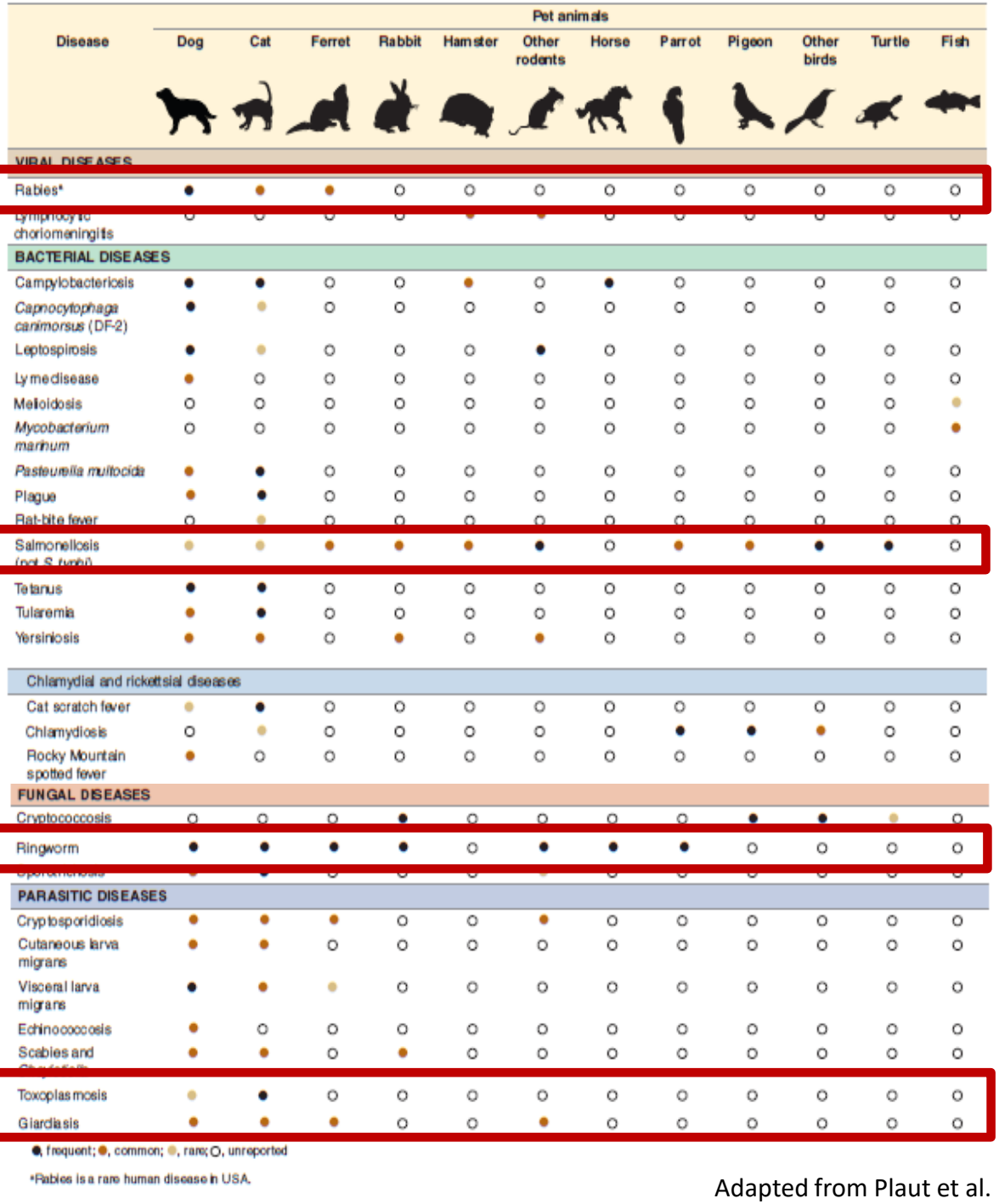
- 63% of zoonotic viruses shared among animals from at least 2 groups
- 45% shared among at least 4 groups
- Central role for domestic animals



Kreuder Johnson et al. 2015

Examples of zoonoses in pets of the USA

- **Bacteria**
  - Feces/ urine: *Salmonella*, *E. coli.*, *Leptospira*, *Shigella*
  - Bites/scratches: *Bartonella* (cat scratch disease), Leptospirosis
  - Vector: plague, Lyme disease, Rocky Mountain spotted fever
- **Viruses**
  - Rabies virus
  - Eastern equine encephalitis virus (EEEV)
- **Fungi**
  - Ringworm
- **Parasites** (protozoa, helminth)
  - Gastrointestinal: tapeworms, cryptosporidium, giardia
  - *Toxoplasma gondii*



Disease	Pet animals: Dog	Cat	Ferret	Rabbit	Hamster	Other rodents	Horse	Parrot	Pigeon	Other birds	Turtle	Fish
VIRAL DISEASES												
Rabies*	●	●	●	○	○	○	○	○	○	○	○	○
Lymphocytic choriomeningitis	○	○	○	○	●	●	○	○	○	○	○	○
BACTERIAL DISEASES												
Campylobacteriosis	●	●	○	○	●	○	●	○	○	○	○	○
Capnocytophaga canimorsus (DF-2)	●	●	○	○	○	○	○	○	○	○	○	○
Leptospirosis	●	●	○	○	○	●	○	○	○	○	○	○
Lyme disease	●	○	○	○	○	○	○	○	○	○	○	○
Melioidosis	○	○	○	○	○	○	○	○	○	○	○	●
Mycobacterium marinum	○	○	○	○	○	○	○	○	○	○	○	●
Pasteurella multocida	●	●	○	○	○	○	○	○	○	○	○	○
Plague	●	●	○	○	○	○	○	○	○	○	○	○
Rat-bite fever	○	●	○	○	○	○	○	○	○	○	○	○
Salmonellosis (not *S. typhi*)	●	●	●	●	●	●	○	●	●	●	●	○
Tetanus	●	●	○	○	○	○	○	○	○	○	○	○
Tularemia	●	●	○	○	○	○	○	○	○	○	○	○
Yersiniosis	●	●	○	●	○	●	○	○	○	○	○	○
Chlamydial and rickettsial diseases												
Cat scratch fever	●	●	○	○	○	○	○	○	○	○	○	○
Chlamydiosis	○	●	○	○	○	○	○	●	●	●	○	○
Rocky Mountain spotted fever	●	○	○	○	○	○	○	○	○	○	○	○
FUNGAL DISEASES												
Cryptococcosis	○	○	○	●	○	○	○	○	●	●	●	○
Ringworm	●	●	●	●	○	●	●	●	○	○	○	○
Sporotrichosis	●	●	○	○	○	●	○	○	○	○	○	○
PARASITIC DISEASES												
Cryptosporidiosis	●	●	●	○	○	●	○	○	○	○	○	○
Cutaneous larva migrans	●	●	○	○	○	○	○	○	○	○	○	○
Visceral larva migrans	●	●	●	○	○	○	○	○	○	○	○	○
Echinococcosis	●	○	○	○	○	○	○	○	○	○	○	○
Scabies and	●	●	○	●	○	○	○	○	○	○	○	○
Toxoplasmosis	●	●	○	○	○	○	○	○	○	○	○	○
Giardiasis	●	●	●	○	○	●	○	○	○	○	○	○

●, frequent; ●, common; ●, rare; ○, unreported

*Rabies is a rare human disease in USA.

Adapted from Plaut et al.

COVID-19: What is known about our pets?

- COVID-19: caused by the SARS-CoV-2 coronavirus
- Few cases in pets (cats and dogs) infected with the virus after contact with people
- No cases reported by CDC in U.S.
- First positive case in an animal in the U.S.: tiger in the Bronx Zoo

Science

REPORTS

Cite as: J. Shi *et al.*, *Science*
10.1126/science.abb7015 (2020).

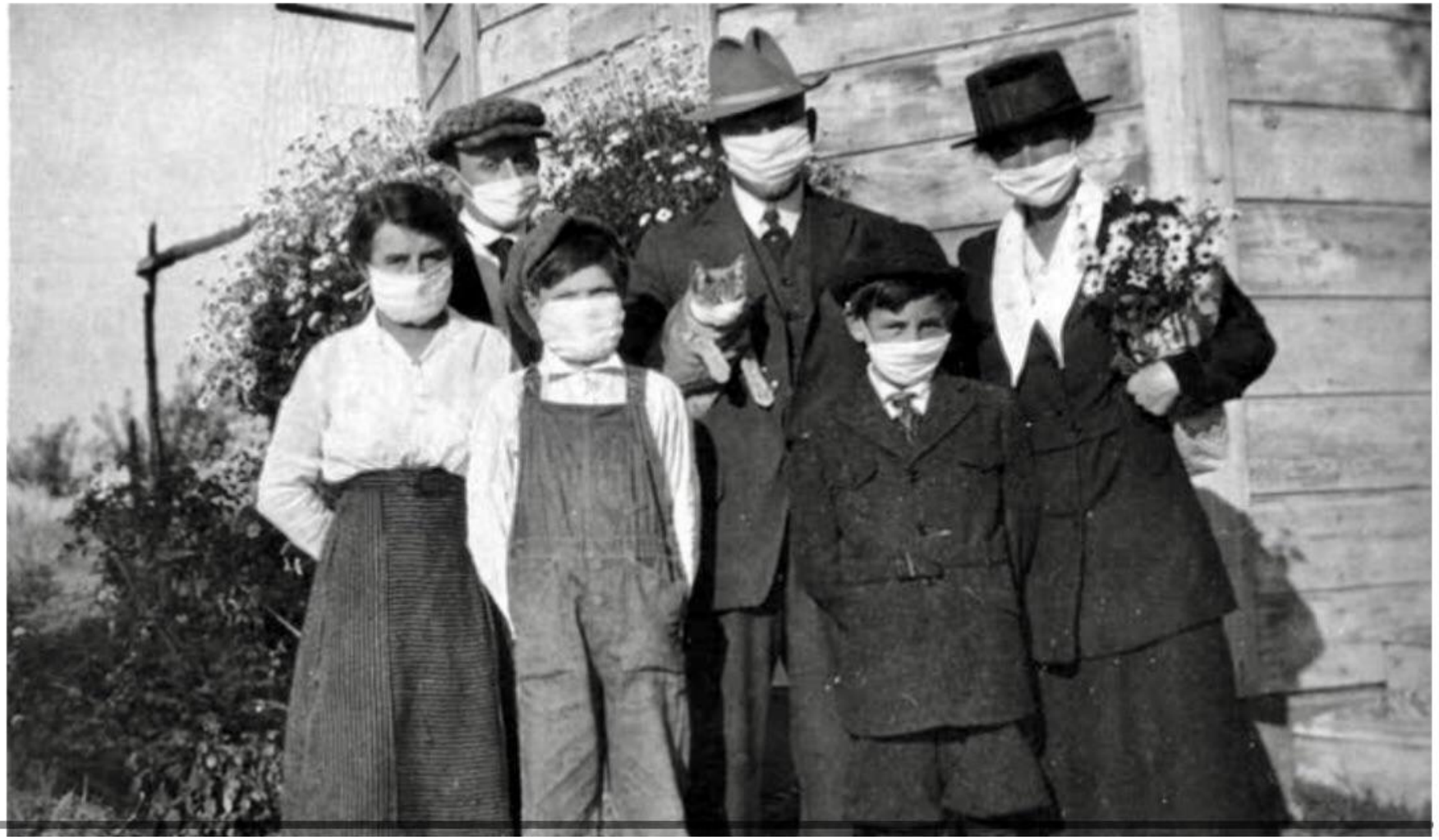
Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS–coronavirus 2

Jianzhong Shi[1]*, Zhiyuan Wen[1]*, Gongxun Zhong[1]*, Huanliang Yang[1]*, Chong Wang[1]*, Baoying Huang[2]*, Renqiang Liu[1], Xijun He[3], Lei Shuai[1], Ziruo Sun[1], Yubo Zhao[1], Peipei Liu[2], Libin Liang[1], Pengfei Cui[1], Jinliang Wang[1], Xianfeng Zhang[3], Yuntao Guan[3], Wenjie Tan[2], Guizhen Wu[2]†, Hualan Chen[1]†, Zhigao Bu[1,3]†

[1]State Key Laboratory of Veterinary Biotechnology, Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Harbin 150069, Peopl
China. [2]National Institute for Viral Disease Control and Prevention, China CDC, Beijing 102206, People's Republic of China. [3]National High Containment Lab
Animal Diseases Control and Prevention, Harbin 150069, People's Republic of China.

- Experimentally infected animals
- SARS-CoV-2 replicates poorly in dogs
- Ferrets and cats were susceptible to airborne infection
- Younger cats were most susceptible
- Zhang et al. 2020 study (unpublished): ~15% cats in Wuhan cohort study were seropositive

1918 Spanish Flu



Zoonotic Disease Prevention

- Cleanliness and environmental sanitation
- Wash hands thoroughly with antiseptic soap, at least 30 seconds
  - Gloves when handling animals with possible zoonoses
  - Sterilization required: use of chemicals, steam under pressure, dry heat
- Avoid contact with pets when you are sick
- Keep cats indoors