Important Zoonotic Diseases of Zoo and Domestic Animals

George V. Kollias, DVM, PhD
Mary E. Martin, DVM, MPH
College of Veterinary Medicine
Cornell University

Zoonoses Lecture Overview

- Definitions
- Infectious Agents
  - Viral
  - Rickettsial
  - Chlamydial
  - Bacterial
  - Fungal
  - Protozoal
  - Parasitic
- Other Zoonotic Concerns
- Special Considerations

Definitions

- **Zoonosis:** any infectious disease that may be transmitted from animals to humans, or from humans to animals (the latter is sometimes called **reverse zoonosis**).
- Reservoirs: +/- signs of disease; balanced relationship beneficial.
- “Dead-end” hosts: unable to transmit infection to others.
- 300+ infectious diseases of humans, 178 of which are zoonotic diseases

During discussion of these diseases consider:

- What is the source and cause of the disease?
- How is it transmitted?
- What preemptive measures can be taken or implemented to limit or prevent transmission?
- What measures should be taken if exposure occurs?

Viral Zoonoses:

- Pox Viruses
  - Contagious ecthyma (Orf)- *Parapoxvirus*
  - Monkey pox- *Orthopoxvirus*

Pox Viruses

- Orf Virus (Contagious Ecthyma)
  - *Parapoxvirus* of sheep, goats, wild ungulates
  - Epithelial proliferation and necrosis of skin and m.m. of urogenital and GI tracts
  - Reservoir: endemic in sheep and goat herds; young animals affected more severely
  - Transmission: humans affected by direct contact with scabs & exudates from lesions

Pox Viruses

- Transmission: humans affected by direct contact with scabs & exudates from lesions;
  - fomite transmission possible
  - Extended environmental persistence
- Clinical signs:
  - Animal: Proliferative, pustular encrustations on lips, nostrils, mm of oral cavity & urogenital orifices

Pox Viruses

- Clinical signs:
  - Humans: often solitary lesions on hands, arms, or face; may be several nodules.
  - Masculopapular → weeping proliferative lesion with ventral umbilication → after 3-6 weeks regress with little scarring
  - Regional lymphadenopathy uncommon

Orf (Contagious Ecthyma)

Umbilicated lesion

www.md.ucl.ac.be

Bioreliance.com

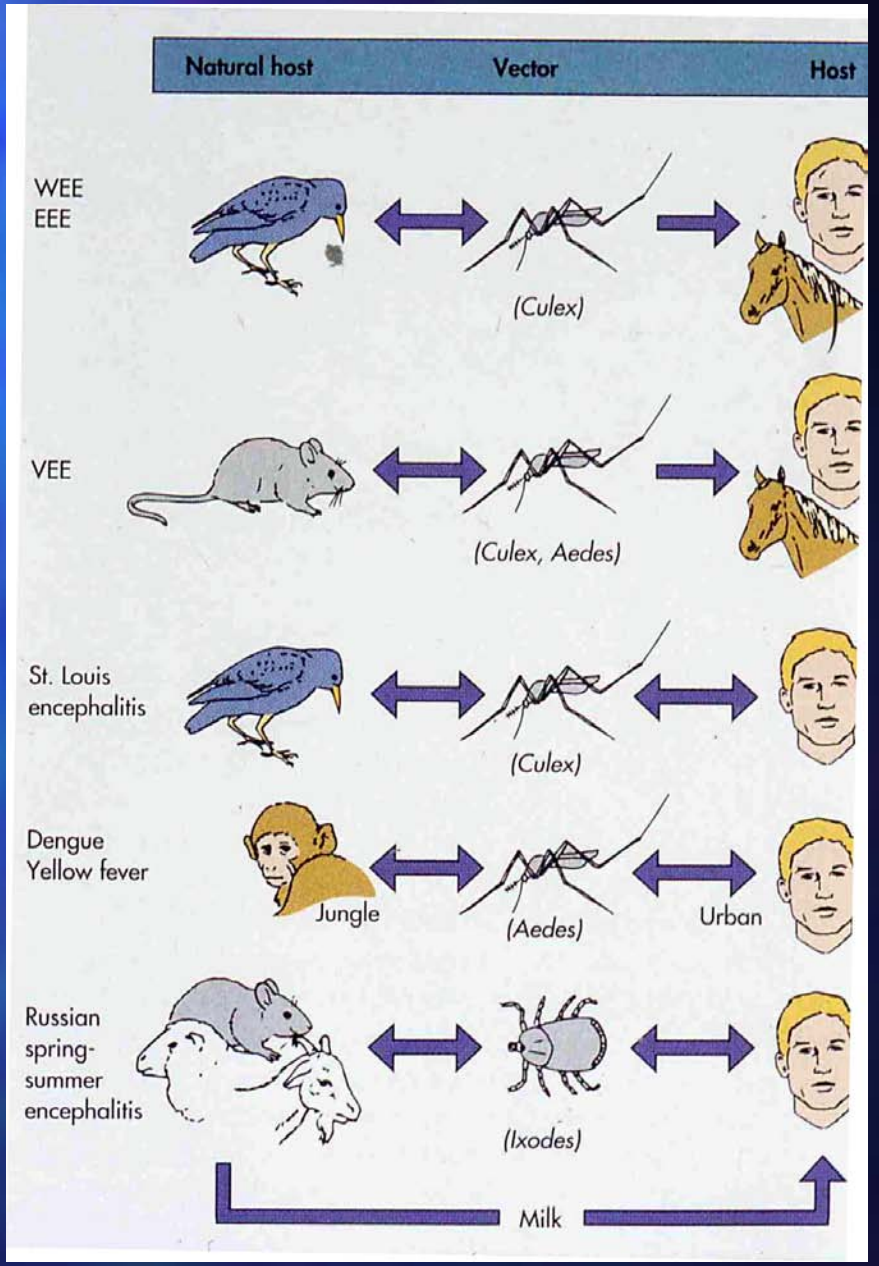
www.acponline.org/bioterro

Sheep infected

dolphin.upenn.edu/~pathclub

Arboviruses

- Arthropod vector
- Can cause encephalitis or hemorrhagic disease
- Humans may be dead-end host, or reservoir for infection



Arboviruses

- Arthropod-Borne Viral Diseases (Arboviral)
  - Venezuelan, Western, and Eastern Equine Encephalomyelitis (VEE, WEE, EEE)- Togaviridae (*Alphavirus)*
  - Dengue, Louping Ill, St. Louis Encephalitis, West Nile Virus, Yellow Fever- Flaviviridae (*Flavivirus)*
  - California encephalitis, LaCrosse encephalitis- Bunyaviridae (*Bunyavirus)*
  - Colorado tick fever- Reoviridae (*Orbivirus)*
  - Vesicular stomatitis- Rhabdoviridae

Hemorrhagic Fevers: Highly unlikely but important to know about

- Marburg Virus Disease
- Flaviviruses- Yellow fever and Dengue
- Ebola/ Filovirus Infections
- Hantaviruses

Marburg Virus

- “Vervet Monkey Disease”- African Green Monkey (*Cercopithecus aethiops*)
- First outbreak in Germany in 1967
- *Filovirus*; natural reservoir has not be determined
- Transmission from direct contact with infected tissues; possibly aerosol

Ebola Virus- Filovirus

- Ebola-Zaire and Ebola-Sudan
  - High mortality in NHP (especially Western Lowland gorillas)
  - High mortality in NHP (death in 8-14 days) Humans- clinical disease not recognized, but animal technicians developed antibody response
  - Reservoir: Wild giant fruit bats

Hantavirus

- Transmission:
  - Inhalation of infectious aerosols
  - Rodents shed virus in respiratory secretions, saliva, urine, feces
  - Animal bite, wound contamination, conjunctival exposure.

Lymphocytic Choriomeningitis Virus (LCM)

- Only virus of mice that naturally infects humans
- Arenaviridae (also includes Lassa Fever)
- Widely present in wild mouse population throughout world.
- Animals most commonly affected: mice, hamsters, guinea pigs, NHPs, swine, dogs.

Lymphocytic Choriomeningitis (LCM)

- Latent infection in mice for period of time
- callitrichid hepatitis- LCMV is etiologic agent; suckling mice fed to tamarins and marmosets to supplement diet.
- Mice and hamsters- may have *in utero* infection

Lymphocytic Choriomeningitis (LCM)

- Pantropic infection: virus present in blood, CSF, nasopharyngeal secretions, feces and tissues;
- Fomite (e.g. bedding material) transmission
- Humans infected:
  - By parenteral inoculation, inhalation,
  - contamination of m.m. or broken skin;
  - organ transplant*.

Lymphocytic Choriomeningitis (LCM)

- Clinical signs (humans):
  - Flu-like illness (fever, malaise, myalgia, headache) → macupapular rash, lymphadenopathy, meningoencephalitis, orchitis, arthritis, epicarditis
  - CNS involvement may cause death
  - Potential infection of fetus *in utero*, causing severe birth defects.

Herpesvirus 1, CHV-1): Unlikely to encounter in a zoo setting but important to know about

- In macaques, produces mild disease similar to human *H. simplex*.
  - 1° infection- lingual and/or labial vesicles or ulcers that heal in 1-2 wks; +/- corneal ulcer or keratoconjunctivitis.
  - Latent infection in trigeminal genital ganglia.
  - Reactivation of viral shedding when stressed physically or psychologically; immunosupressed
  - Endemic infection in some colonies- up to 100%

B-Virus Infection

- Transmission to humans: exposure to contaminated saliva (bites, scratches), ocular m.m. exposure, needlestick, exposure to tissues, fomites (cages), human-to-human (1 case)
- Incubation 2 days to 2-5 wks.
- Clinical signs: herptiform lesion at site of inoculation → myalgia, fever, headache, fatigue → progressive neurological disease → death (80% fatality rate)
- Herpes simplex ("Cold Sores") of humans can cause illness and or death in NHP, especially lesser and greater apes.

B-Virus Infection

- Handle all macaques as potentially Herpes-B positive!!
- Strict PPE in place; SOPs developed.

Rabies

- *Lyssavirus*, family Rhabdoviridae
- Worldwide distribution
- Infects all mammals, but main reservoirs are wild and domestic canines, cats, skunks, raccoons, and bats.

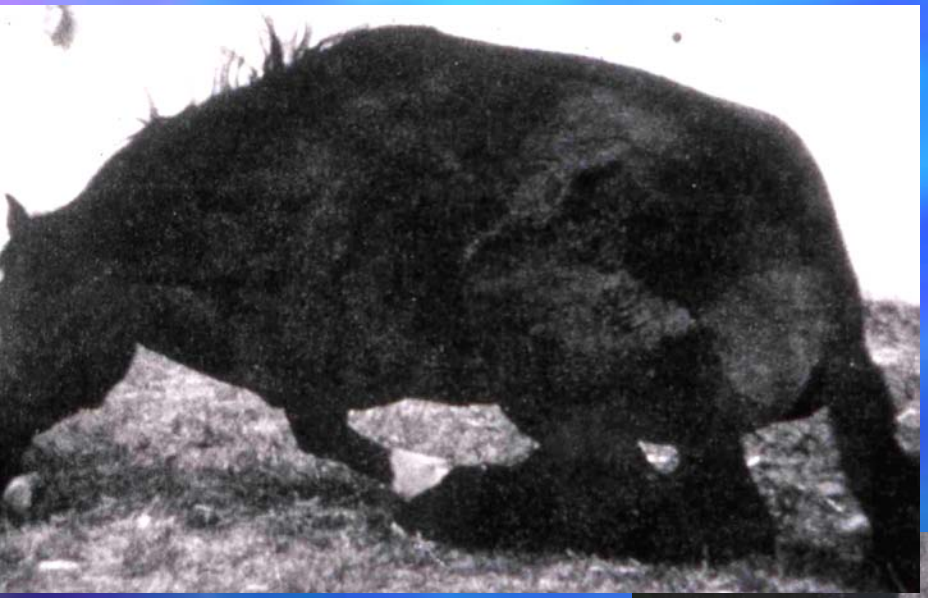
Rabies

- Transmission: bite of rabid animal, or introduction of virus-laden saliva on skin wound or mucous membranes
  - Corneal transplant from infected person
  - Airborne transmission in lab setting, and in caves where rabid bats roost.

Rabies

- Incubation:
  - 1-3 months (varies 9 days to >8 months)
  - Prodromal → acute neurologic → coma → death (rarely recovery)
- Diagnosis: Negri bodies (hippocampus), rabies virus antigen (Direct FA)
- Prevention: Avoid contact and vaccination- both very effective

Rabies



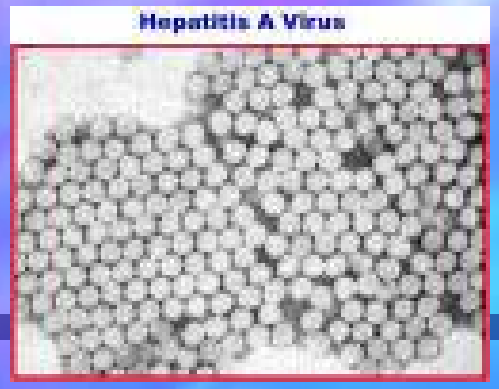
CDC

Viral Hepatitis Infections

- Hepatitis A- human enterovirus of family Picornaviridae
  - Primary reservoirs are humans;
  - NHP infections are from humans or other infected NHPs
  - Humans have been infected from newly imported chimps
  - Transmission: fecal-oral route

Viral Hepatitis Infections

- Clinical signs:
  - Generally less severe than in humans, frequently subclinical
  - Clinical disease in chimps, owl monkeys, marmosets- malaise, vomiting, jaundice, ↑ liver enzymes
  - Humans- mild to severely debilitating; fever, malaise, anorexia, nausea, jaundice (no chronic carrier state)



Hepatitis A

- Vaccine now available- recommended for high-risk individuals

Retroviruses

- Simian Immunodeficiency Virus (SIV)
  - Lentivirus, infects OW primates
  - Clinical syndrome in macaques (parallels AIDS)
  - Horizontal and vertical transmission
  - Seroconversion in people- no clinical disease
- Simian Foamy Virus Infection
  - New and Old World NHPs
  - Close homology to human foamy viruses
  - Seroconversion, no disease

Measles Virus (Rubeola, Giant Cell Pneumonia

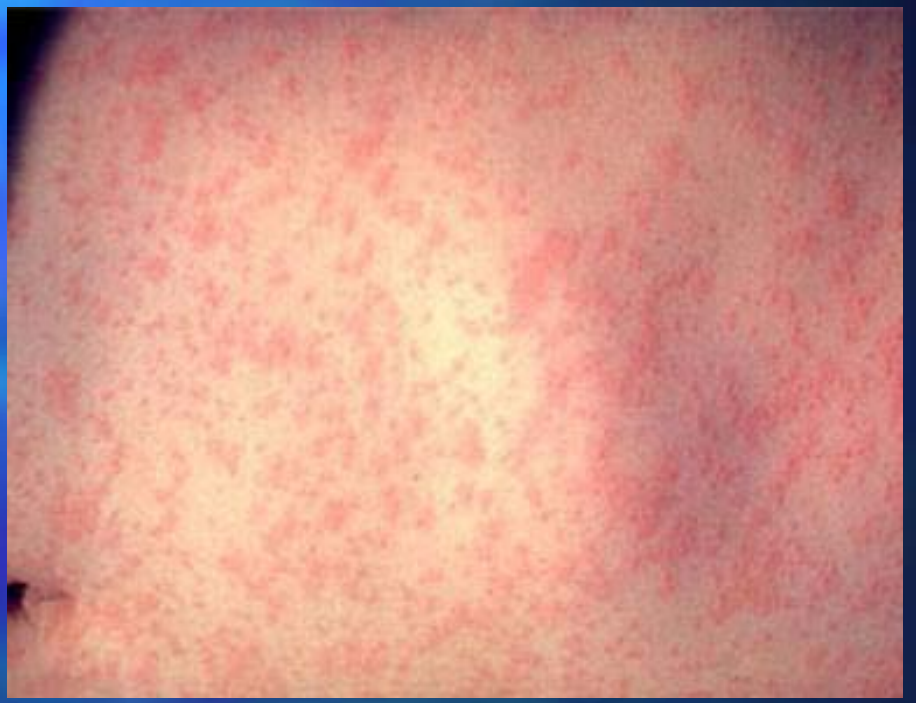
- *Morbillivirus*- cause infection in wide variety of Old and New World NHP species.
- Humans serve as reservoir for infecting NHPs
- Disease spreads rapidly thru infected colonies; New World monkeys more vulnerable, less likely to survive
- Transmission: Aerosol and direct contact with respiratory secretions

Measles Virus

- Clinical signs (humans and NHPs):
  - Fever, conjunctivitis, coryza, cough, Koplik's spots on buccal mucosa
  - Erythematous rash develops face, then generalized
  - Complications: bronchopneumonia, otitis media, diarrhea, encephalitis
  - Prevention: Vaccination

Koplik's Spots

Measles rash

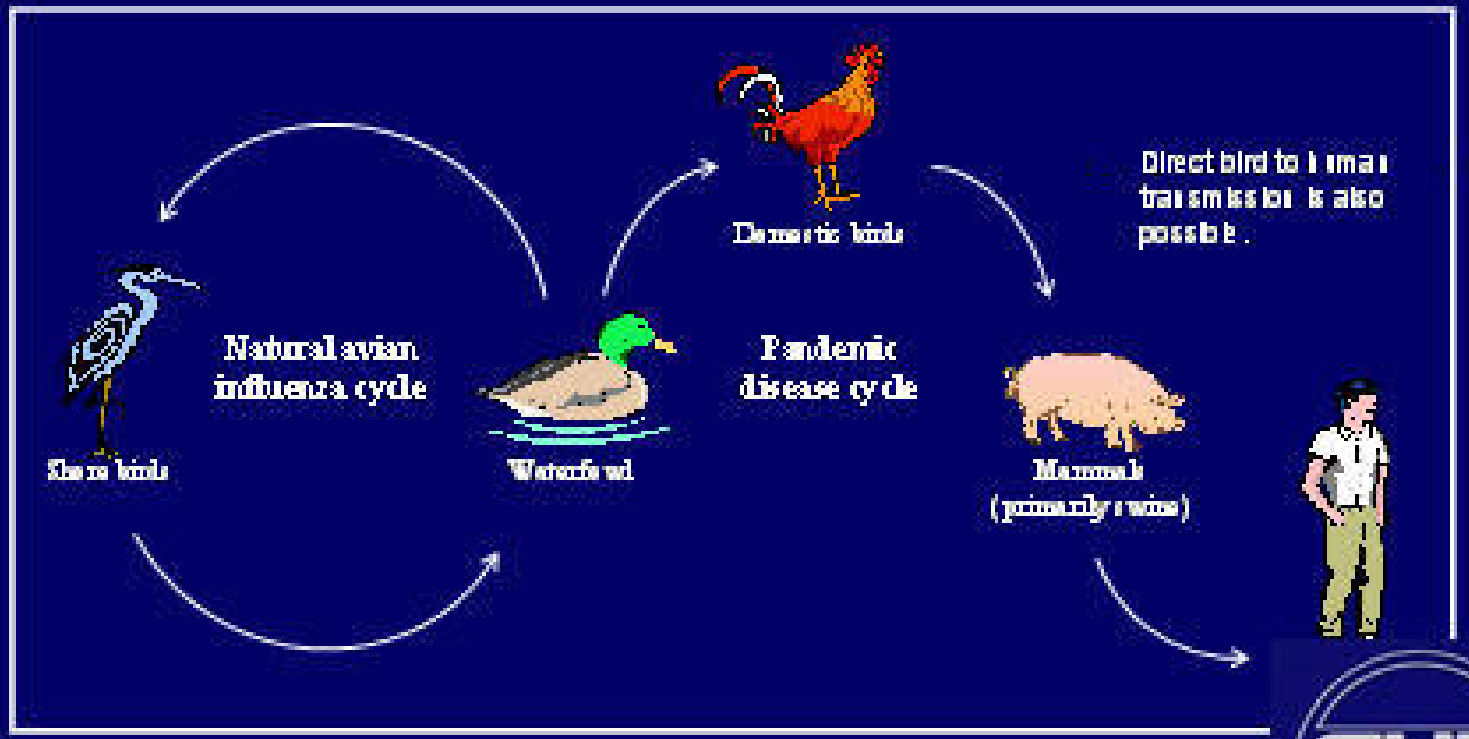


www.imcworldwide.org

Influenza

- Humans are reservoir for human influenza virus.
- Many different antigenic strains in other species: avian, swine, horses, ferrets, minks, seals
- Animal reservoirs contribute to emergence of new human strains by passage of avian flu thru pigs ; multiple mutational or re-assortment occurs.
- Ferrets very susceptible to human strains (animal model)

Cycle of Avian Influenza Viruses in Animals & Humans



www.ehagroup.com

Rickettsial Diseases- caused obligate intercellular bacteria

- Murine typhus (Endemic Typhus)
- Rocky Mountian Spotted Fever
- Rickettsial Pox
- *Coxiella burnetti* (Q fever)
- Ehrlichiosis (Anaplasmosis)

Q Fever
Coxiella burnetti

- Domestic animal cycle mostly involves sheep, goats and cattle
- Also found in cats, wild rabbits, birds, others
- Transmission: Shed in urine, feces, milk, placental tissue of domestic ungulates that are asymptomatic
- Highly infectious- 10 organisms can cause disease
- Sporelike form highly resistant to desiccation; persists in environment

Q Fever

- Varies in severity and duration; may be asymptomatic
- Often flu-like illness- fever, frontal headache with retro-orbital pain, chest pain, pneumonia
- Serious extrapulmonary complications: acute or chronic hepatitis, nephritis, epicarditis, endocarditis

Bacterial Zoonoses: Chlamydial Conjunctivitis

- *Chlamydophila psittaci* in bird host, esp. psittacines; most frequent source of infection
- Birds: Conjunctivitis, pneumonitis, air sacculitis, pericarditis, hepatitis, meningoencephalitis, endometritis, abortion
- Humans: usually upper respiratory infection; may have severe complications

Leptospirosis

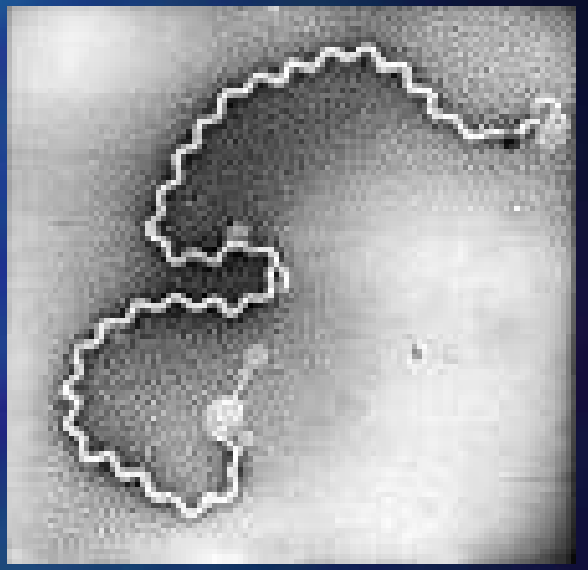
- Many serotypes:

  -Leptospira interrogans, L. ballum, L.icterohemorragiae, L.hardjo, L canicola, L. autumnalis, L. bratislava, L.pomona
- Reservoirs: rodents, rabbits, livestock, raccoons
- Transmission: handling infected animals and their secretions (especially urine), aerosol exposure, rodent bites

Leptospirosis

- Clinical signs:
  - Varies form inapparent to severe infection and death
  - Bi-phasic disease:
    - First: Weakness, headache, myalgia, chills and fever, leukocytosis
    - Later: Conjunctival suffusion, +/-rash, renal, hepatic, pulmonary, GI involvement, jaundice
    - Prevention: Avoid exposure. Vaccination +/- effective

Leptospirosis- Jaundice



Enteric Diseases

- *Campylobacter jejuni* and *C. coli*
  - many lab animal species; fecal-oral
- Helicobacteriosis
- Salmonellosis
  - 2400 serotypes
  - Ubiquitous in nature; food and water contaminated by carriers

Shigellosis

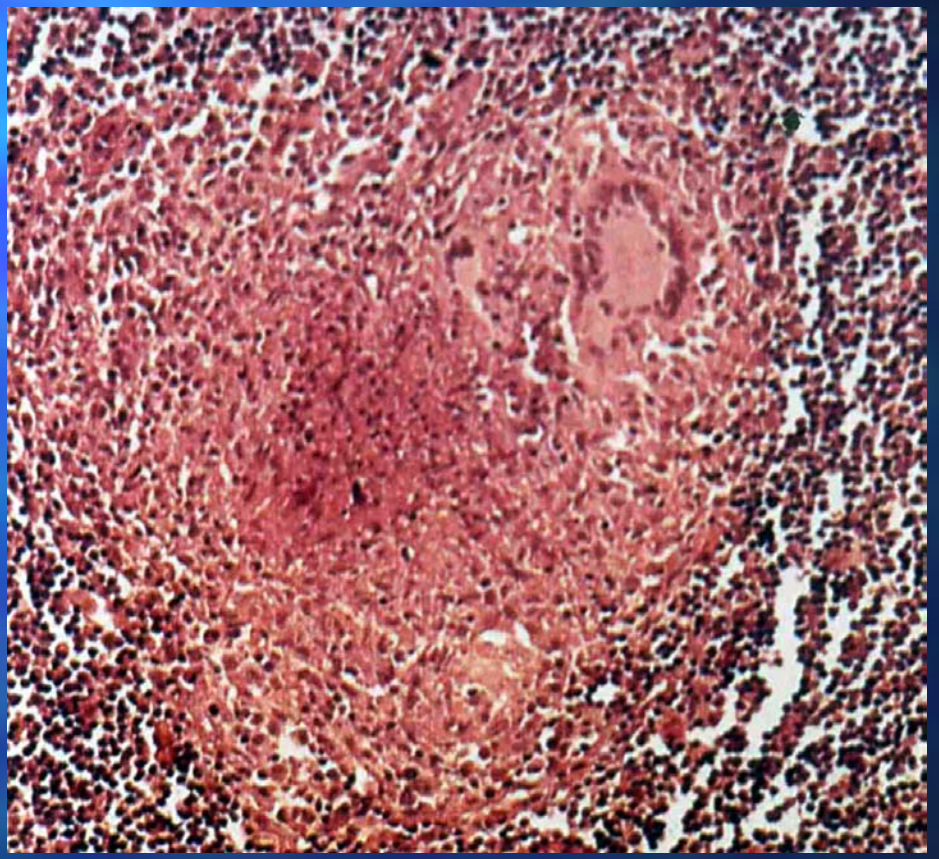
- Shigellosis- NHP zoonoses
  - *Shigella flexneri, S. sonnei, S. dysenteriae*
  - Humans are main reservoirs of disease
  - Transmission: Fecal-oral, direct contact
  - Clinical signs:
    - Asymptomatic to bacillary dysentery (Blood and mucus in feces abdominal cramping, tenesmus, weight loss, anorexia
    - Survivors can remain carriers

Tuberculosis

NHP usually acquire disease from humans

Transmission: aerosol, ingestion of bacterium

Clinical signs: usually pulmonary; may include weight loss, fatigue, fever, chills, cachexia



Tuberculous Granuloma

Monkey- Positive TB Reactor

Tularemia

- **“Rabbit Fever”, “Deer Fly Fever”**
- ***Francisella tularensis*- small gram-neg. coccobacillus w/ thin lipid capsule.**
- **Intracellular bacteria of macrophages; inhibits phagosome/ lysosome fusion.**
- **Highly infectious with low infectious dose, ease of dissemination, this makes organism a potential biological weapon.**

Tularemia
Francisella tularensis

- World-wide, with wide range of hosts.
- Syndromes depend on route of exposure.
- Transmission: aerosol (respiratory or conjunctival), ingestion, and via wounds

Tularemia

Rat Bite Fever

Streptobacillus moniliformis
-Streptobacillary fever; Haverhill Fever (ingested of contaminated food, water or raw milk)

Spirillum minus- causes Sodoku or Spirillosis

Symptoms: fever, lymphadenopathy, inflammation, flu-like symptoms +/-rash; Arthritis in 50% of *S. moniliformis* infections.

“Cat Scratch Disease”

Bartonella henselae

-bitten or scratched by cat

-most <20 yrs. old

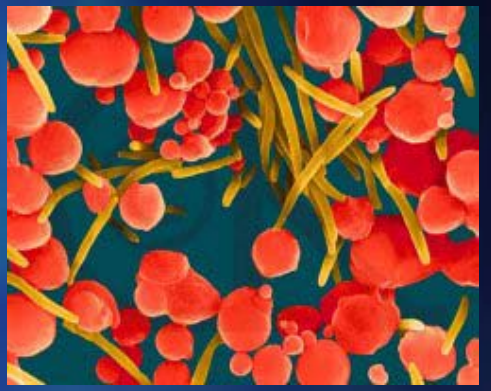
-Organism also shed in feces of flea (cat-to-cat, cat-to-human transmission)

Mild fever, erythematous pustule, regional lymphadenopathy.

Regresses in 6 wks.; usually benign

-Occasionally systemic illness

Capnocytophaga canimorsus
"Dog Bite Fever"



-Fever, cellulitis, septicemia, purulent meningitis and endocarditis develop.
-Patient is asplenic.
-7 days after bite, patient dies. (True story)

Other Infectious Zoonotic Agents

- Fungal Diseases:
  - Dermatophytosis (Ringworm)- *Microsporum, Trichophyton mentagrophytes*
- Parasitic Diseases:
  - Protozoa-
    - Leishmaniasis- *Leishmania* species
    - Babesiosis- *Babesia microti* (in U.S.)
    - Toxoplasmosis- *Toxoplasma gondii*
    - Amoebiasis- *Entamoeba histolytica*
    - Cryptosporidiosis- *Cryptosporidium parvum*
    - Giardiasis- *Giardia lamblia (G. duodenalis)*

Ringworm (*Microsporum*)

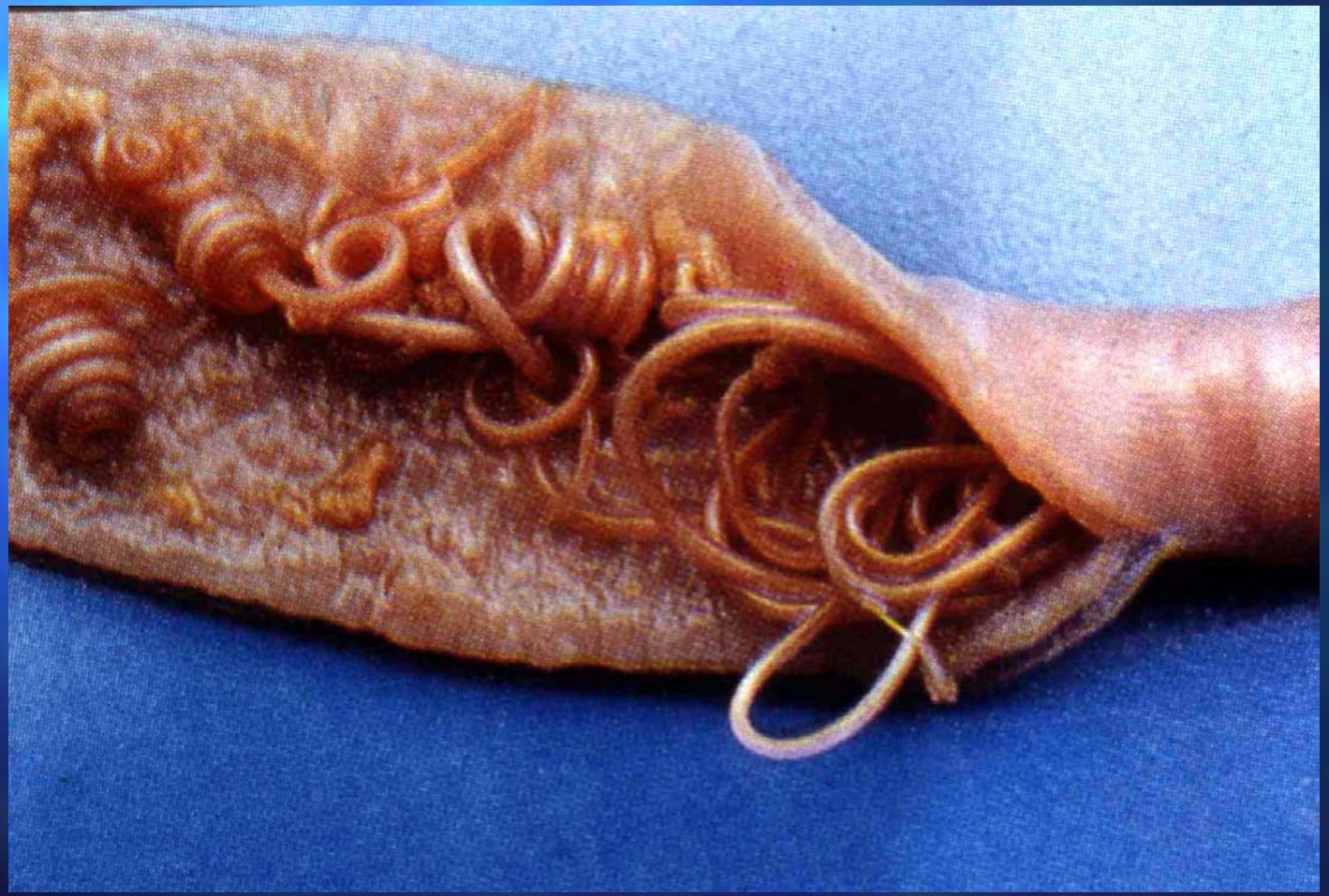
Ringworm (Human)

Infectious Zoonotic Agents

- Parasitic Diseases:
  - Nematodes:
    - Hookworms- *Ancylostoma* spp.
    - Roundworms- *Toxocara* and *Baylisascaris* spp.
    - Capillary liver worm (*Capillaria hepaticus)*
    - Heartworm- *Dirofilaria immitis*
  - Cestodes: (Tapeworms)
    - Cystic Hydatid Disease- *Echinococcus granulosis*
    - Alveolar Hydatid disease- *E. multilocularis*
    - Beef and pork tapeworm(*Taenia saginata* and *T. solium)* ; Cysticercosis is larval stage of *T. solium*

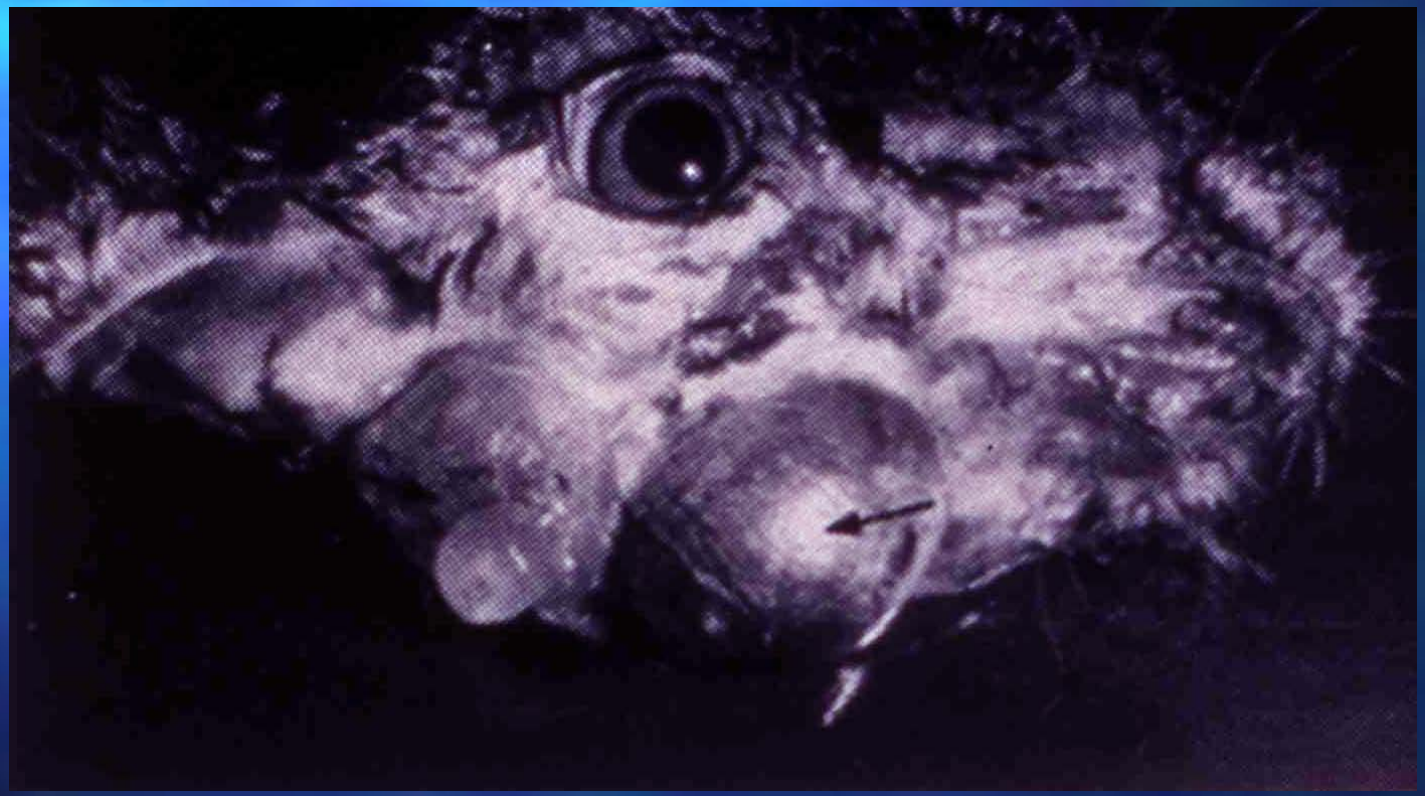
Hookworm ("Creeping Eruption"

Roundworms- Dog



Leukocoria (“White eye”) from Visceral Larval Migrans

Tapeworm-*Taenia*
Cysts in a rabbit



Other Zoonotic Concerns

- Ectoparasites
  - Flea and tick bites; bee sting; flea allergy dermatitis; mange
- Allergies
  - fur, dander, insect bites
- Trauma
  - Bites, scratches, snake bites

Sarcoptic Mange

Special Risk Considerations

- Environment (rural vs urban, hi vs low income)
- Immune Status (children, immunocompromised)
- Pregnancy (teratogens, *in utero* infections)
- Special Interests/Hobbies (hiking- tick exposure)
- International travel (tropical diseases)
- Veterinarians (high risk for bites, exposure to agents)
- Animal Care Personnel

Zoonoses Lecture Wrap-up

- Definitions
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  - Bacterial
  - Fungal
  - Protozoal
  - Parasitic
- Other Zoonotic Concerns
- Special Considerations

Resources

- Government Agencies:
  - Centers for Disease Control and Prevention (CDC)
  - State Health Agencies
- Texts:
  - *Control of Communicable Disease Manual* J. Chin (editor) APHA 2000
  - *Handbook of Zoonoses- 2nd Edition* (2 vol.) G. Beran (editor) CRC Press 1994