

Zoonoses: Convergence of Animal and Public Health

Zoonotic disease overview

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Implications for foodborne illness prevention

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What is a zoonosis?

“Those diseases and infections which are naturally transmitted between vertebrate animals and man” (WHO)

An old concept with new dimensions:

- New emerging diseases
- Growing populations and increased movement
- Changing agriculture and husbandry practices
- Climate and environmental change
- Bioterrorism threats
- Cultural and social change



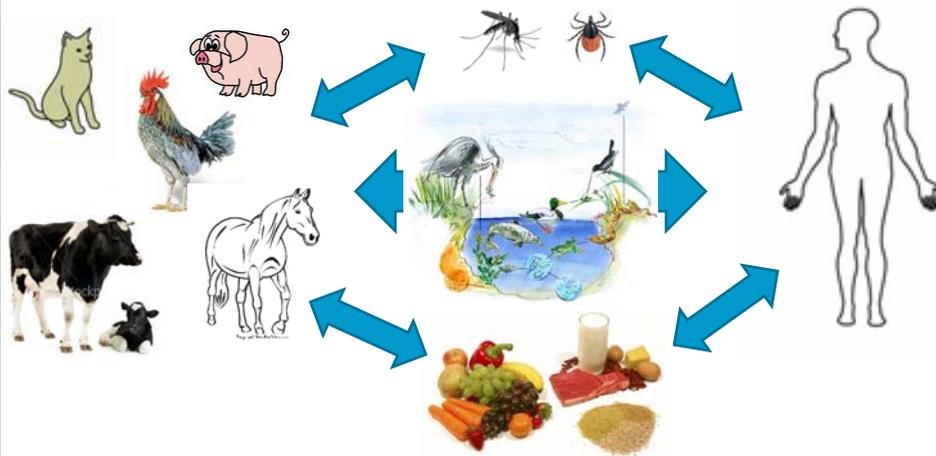
Rudolf Virchow
1821-1902
‘One Medicine’

Common misconceptions:

- Causes disease in animals
- Animal host is natural reservoir
- Transmission route to humans is simple and direct

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Transmission Modes for Zoonotic Diseases



II. Background & Trends

- 75% of emerging diseases are zoonotic
- Zoonotic agents comprise more than 80% of the CDC-listed biothreat agents of concern:

• Anthrax (<i>Bacillus anthracis</i>)	• Q fever (<i>Coxiella burnetii</i>)
• Arenaviruses	• Ricin toxin from <i>Ricinus communis</i> (castor beans)
• Botulism (<i>Clostridium botulinum</i> toxin)	• <i>Salmonella</i> species (salmonellosis)
• <i>Brucella</i> species (brucellosis)	• Salmonellosis (<i>Salmonella</i> species)
• <i>Chlamydia psittaci</i> (psittacosis)	• <i>Shigella</i> (shigellosis)
• Cholera (<i>Vibrio cholerae</i>)	• Smallpox (variola major)
• Ebola virus hemorrhagic fever	• Staphylococcal enterotoxin B
• <i>E. coli</i> O157:H7 (<i>Escherichia coli</i>)	• Tularemia (<i>Francisella tularensis</i>)
• Emerging infectious diseases: Nipah virus and hantavirus	• Typhoid fever (<i>Salmonella</i> Typhi)
• Epsilon toxin of <i>Clostridium perfringens</i>	• Typhus fever (<i>Rickettsia prowazekii</i>)
• Food safety threats (e.g., <i>Salmonella</i> species, <i>Escherichia coli</i> O157:H7, <i>Shigella</i>)	• <i>Vibrio cholerae</i> (cholera)
• Glanders (<i>Bacteroides mallei</i>)	• Viral encephalitis
• Lassa fever	• Viral hemorrhagic fevers (filoviruses [e.g., Ebola, Marburg] and arenaviruses [e.g., Lassa, Machupo])
• Marburg virus hemorrhagic fever	• Water safety threats (e.g., <i>Vibrio cholerae</i> , <i>Cryptosporidium parvum</i>)
• Melioidosis (<i>Bacteroides pseudomallei</i>)	
• Plague (<i>Yersinia pestis</i>)	

Source: OIE, CDC, 2003a; IOM and NRC, 2008



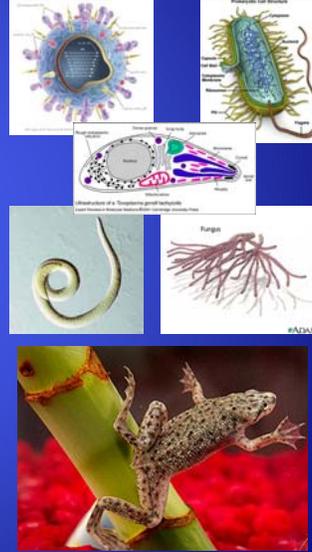
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Zoonoses and Risk Factors for Human Disease Emergence

- Taylor LH, Latham SM, Woolhouse ME. *Risk factors for human disease emergence*. *Philos Trans R Soc Lond B Biol Sci*. 2001;356:983–9.
 - A comprehensive literature review identifies **1415 species of infectious organism known to be pathogenic to humans...**
 - Out of these, **868 (61%) are zoonotic**, that is, they can be transmitted between humans and animals, and **175** pathogenic species are associated with **diseases considered to be 'emerging'**.
 - **Out of the emerging pathogens, 132 (75%) are zoonotic**, and overall, zoonotic pathogens are twice as likely to be associated with emerging diseases than non-zoonotic pathogens.
- **Emerging Disease:** A new infection resulting from the evolution or change of an existing pathogenic agent, a known infection spreading to a new geographic area or population, or a previously unrecognized pathogenic agent or disease diagnosed for the first time and which has a significant impact on animal or public health.

Classic 'Old' Zoonoses

Rabies
Trichinosis
Tuberculosis
Brucellosis
Salmonellosis
Anthrax
Plague
Tularemia
Leptospirosis
Psittacosis
Q fever
Toxoplasmosis
Ringworm
Influenza



Emerging 'New' Zoonoses

H1N1 'Swine' Flu:

- 2009 pandemic flu
- Re-assortment of viruses with swine and avian hosts

H5N1 'Bird' Flu:

Monkey Pox:

- 2003 U.S. - Prairie Dogs
- Imported Gambian Rats

BSE (Mad Cow Disease):

- Transmissible Spongiform Encephalopathy
- Variant CJD

Multidrug Resistant Salmonella

MRSA (Methicillin Resistant Staph Aureus)

Hendra Viruses:

- Nipah virus swine (1998 Malaysia)
- Morbillivirus equine (1994 Australia)
- Fruit bat reservoir

West Nile Virus

Lyme Disease

Cryptosporidia



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The Perfect Microbial Storm



“There will be no calm because the forces that create the perfect storm will continue to collide and the storm itself will be a recurring event”

Emerging and Re-emerging Zoonoses 1996-2004 (Source: WHO)



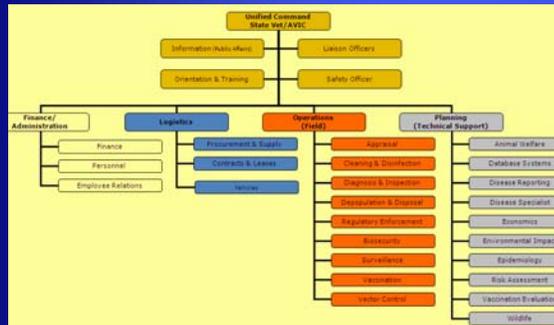
Other Impacts of Zoonotic Disease

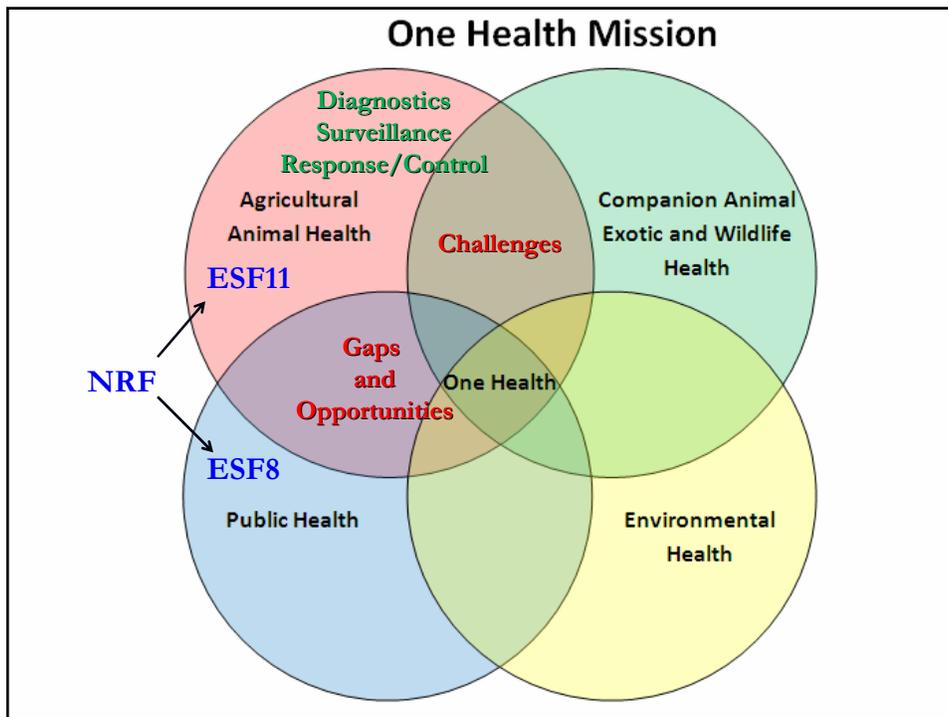
- **Agricultural Products**
 - Vegetables contaminated with E. coli 0157:H7
- **Food Safety**
 - Trade restrictions may be placed on products like eggs and milk
- **Conservation Issues**
 - Endangered wildlife populations may be at risk for extinction (gorillas and measles)
- **Economic Impact**
 - Typically, the animal reservoirs of many zoonotic diseases are of economic importance (livestock) or provide social well being (companionship)
- **Livestock productivity**
 - Zoonotic pathogens may result in control costs or production losses

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Zoonotic Disease Response

Size/Scale
 Authorities
 Complexity
 Jurisdictions
 Resources



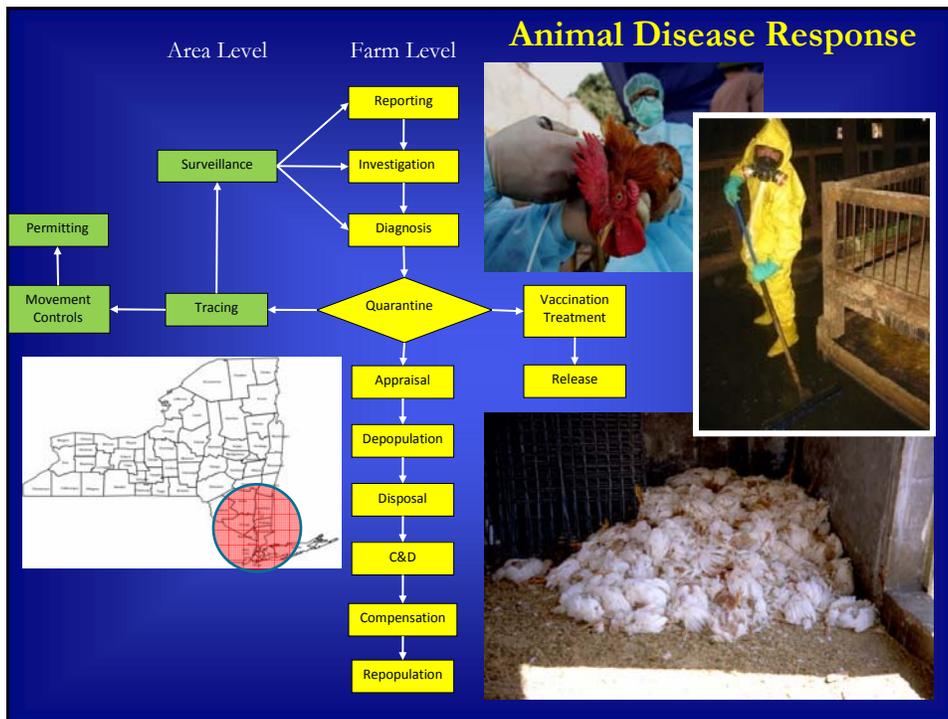


Zoonotic Disease Response

ESF #11 (USDA/APHIS) provides for an integrated Federal, State, tribal, and local response to an outbreak of a highly contagious or economically devastating animal/**zoonotic** disease ...

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graph LR
    NRF[National Response Framework] --> ESF11[ESF11 Ag & Nat Res]
    NRF --> ESF8[ESF8 Public Health Med Services]
    ESF11 -- USDA APHIS --> AD[Animal Disease Response]
    ESF11 -- USDA FSIS --> FSS1[Food Safety and Security Meat Poultry & Eggs]
    ESF8 -- HHS FDA --> FSS2[Food Safety and Security]
    ESF8 -- HHS --> PHR[Public Health Response]
  
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USDA APHIS VS Resources

- National Veterinary Stockpile
- Incident Management Teams (4)
- NVSL/FADDL Laboratories
- NAHLN Laboratory Network
- NAHERC Veterinary Reserve Corps

The image shows a stack of grey boxes labeled "FAD Prep" (Foreign Animal Disease Preparedness). The categories listed on the boxes are: Surveillance, Epidemiology, Vaccination, Contingency of Business, More Checks, and More Checks. The bottom of the stack is labeled "NADP-United Planning".

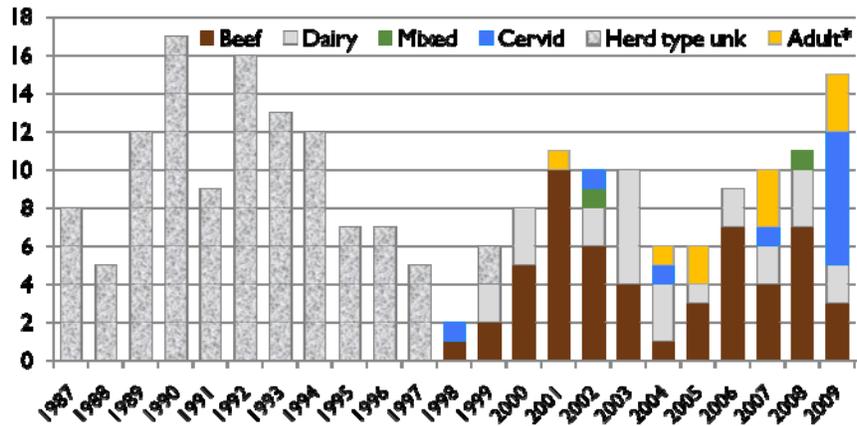
The map shows the National Animal Health Laboratory Network (NAHLN) across the United States. The map is titled "National Animal Health Laboratory Network (NAHLN)". It shows various laboratories across the country, with a legend indicating the types of diseases they are approved for. The legend includes: Newcastle Disease (ND)/Avian Influenza (AI), Bovine Spongiform Encephalopathy (BSE), Swine/Cquine/Wilding Disease (SCWD), Classical Swine Fever (CSF)/Foot and Mouth Disease (FMD), Pseudorabies Virus (PRV), Swine Influenza (SVI), and Vesicular Stomatitis (VSV). The map also includes a note: "Approved Laboratories" and "National Veterinary Services Laboratories".

The image shows two photographs: a person in a white protective suit and mask standing in a field, and a person in a white lab coat holding a vial.

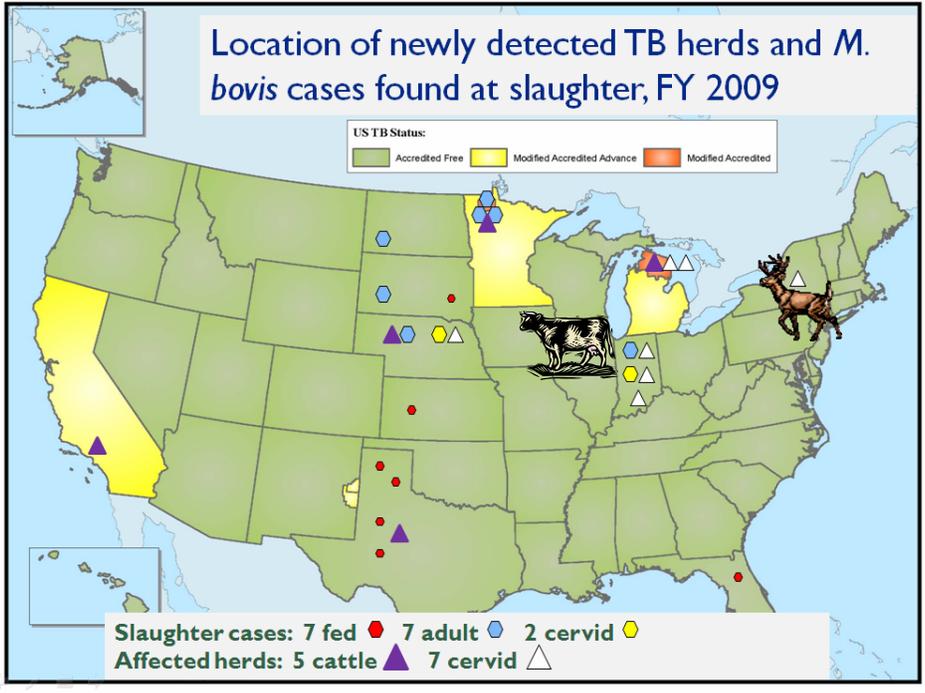
The image shows an aerial view of a coastal area with a large body of water and a small island.

Tuberculosis: *Mycobacterium Bovis*

Affected Cattle and Captive Cervid Herds, 1987–2009



Location of newly detected TB herds and *M. bovis* cases found at slaughter, FY 2009



M. Bovis

■ Surveillance

- Slaughter Surveillance
- Herd Testing

■ Response

- Quarantine, Indemnity and Depopulation
- Quarantine, Test and Remove

■ Zoonotic Issues

- Migrant Laborers and Reverse Zoonosis (M. Tb)
- Raw milk consumption

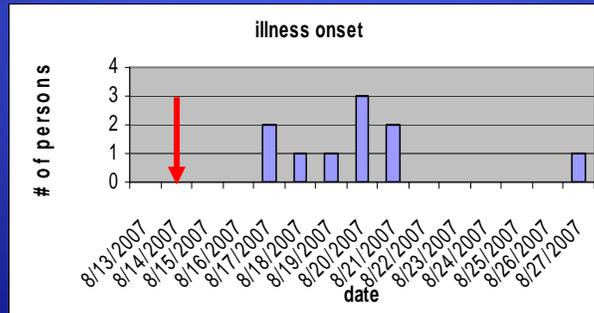


Case Scenario: August 14, 2007

- A severe storm with high winds damaged a dairy farm used as a teaching facility by the University of Minnesota college of Veterinary Medicine.
- A call for help went out to any available veterinary student to assist with the clean up.



- Friday August 31, several reports of illness among students.
 - 2 students reported diarrhea, one student was sick enough to be admitted to the ER and placed on IV fluids.
 - **Cryptosporidiosis** diagnosed
- 26/36 (72 %) ‘responders’ responded to survey
- 10/26 respondents reported illness
- Case definition; “persons who have been sick with vomiting or diarrhea since August 14, 2007.”



Summary of significant risk factors:

Risk factor	Odds ratio
Assigned to public health rotation during visit to TMF	16.67
Clinical track small animal	24.5 (p-value 0.003)
Wear coveralls while at the TMF (protective)	0.25 (p-value 0.137)
Were you raised on farm	0.32 (p-value 0.17)

State Veterinarian Offices

State	Location	Contact Number
Illinois	Illinois Department of Agriculture	217-782-4944
Indiana	Indiana State Board of Animal Health	317-544-2400
Michigan	Michigan Department of Agriculture	517-373-8200
Minnesota	Minnesota Board of Animal Health	651-201-6825
New York	New York State Department of Agriculture & Markets: Division of Animal Industry	518-457-3502
Ohio	Ohio Department of Agriculture: Division of Animal Industry	614-728-6220
Pennsylvania	Pennsylvania Department of Agriculture: Bureau of Animal Health and Diagnostic Services	717-772-2852
Wisconsin	Wisconsin Department of Agriculture, Trade and Consumer Protection: Animal Health Division	608-224-4880

USDA, APHIS, VS Area Office for Veterinarian-in- Charge

State	Contact Number
Illinois	217-547-6030
Indiana	317-347-3100
Michigan	517-324-5290
Minnesota	651-290-3691
New York	518-218-7540
Ohio	614-856-4735
Pennsylvania	717-237-7440
Wisconsin	608-662-0600