Bovine Tuberculosis Transmission between humans and animals: A Zoonotic Disease of Concern

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Disclosures

• None
Learning Objective

• Utilize knowledge of zoonotic TB when conducting patient interviews to determine if patient has livestock exposure

• Document and communicate within your agency all livestock exposure for patients diagnosed with *Mycobacterium tuberculosis complex*. 
Division of Animal Health: Who are we?

- Animal Health Veterinarians
- Safeguard Animal Health
- Economic viability
- Public Health
Who Do We Work With?

- Zoonotic Diseases
  - Department of Agriculture, Trade and Consumer Protection
  - USDA-APHIS-VS
  - Private Veterinarians
  - Farmers
  - Department of Public Health
  - Local Health Departments
  - Medical Doctors
  - Department of Natural Resources
  - USDA Wildlife Services
  - Hunters
What are Zoonotic Diseases?

- At least **60%** of all human pathogens (CDC)
- **75%** of recently **emerging** infectious **diseases** that affect humans are of animal origin
- Most dangerous of these animal diseases pose catastrophic risks to human health, livestock health and the global **agricultural economy**
- Ag employs one out of every three workers worldwide, according to the United Nations.
TB History & Significance

- In 1900, the US human mortality rate from TB was 200 per 100,000 annually (Grigg, 1958)

- 6% and 30% cases
  - *M. bovis* acquired from drinking infected milk. (Centers for Disease Control & Prevention, 1992)

Adapted from USDA APHIS VS  
Image: https://en.wikipedia.org/wiki/Tuberculosis
**M. tuberculosis complex**

- *M. tuberculosis*
  - Elephants
- *M. africanum*
- *M. microti*
- *M. bovis*
  - Bovine tuberculosis

Photo: https://en.wikipedia.org/wiki/Tuberculosis
Bovine TB: History

- 1600s  TB imported with European cattle
- 1882  Koch discovers tubercle bacillus (*M. bovis*)
- 1900s  TB leading cause of death in people in US
  - Est. 6-30% of human TB cases are *M. bovis*

Photo:https://en.m.wikipedia.org/wiki/Margaret_Thatcher#Education_Secretary_and_Cabinet_minister:_1970.E2.80.9374

Adapted from USDA APHIS VS
Tuberculosis in the United States

- 1915, it was estimated that 10% of dairy cattle
and 2% of beef cattle were infected with *M. bovis*.

Photo: https://en.wikipedia.org/wiki/Dairy_farming

Adapted from USDA APHIS VS

Source: Olmstead and Rhode, 2004, An Impossible Undertaking
Bovine TB: History

- 1910s Milk pasteurization, meat inspection begins
- 1917 National eradication program begins
  - ~5% of all US cattle infected with TB
  - 1922 mandatory
- 1918 Cost to industry
  - $40 Million

https://en.wikipedia.org/wiki/The_Jungle
Bovine TB Eradication History

- Estimated cost of bovine TB eradication program from 1917 to 1962
  - $3 billion in 2003 dollars
- Benefits from the program
  - Est 12 times the cost
- TB program estimated to save 25,000 human lives annually
  - 1,125,000 total saved lives during 45 year period

Bovine TB: Zoonotic

- Primary reservoir - cattle or wildlife
- People exposed
  - Raw milk or raw milk products
  - Rarely inhalation
- Human to human transmission possible
- Infected people may transmit infection to cattle
- Wildlife reservoirs vary
Average 8 new herds per year
Slaughterhouse Surveillance

https://www.flickr.com/photos/usdagov/7087367669

Photo: USDA APHIS VS
Bovine TB: Necropsy
Lymph Nodes

- Tracheal-Bronchial
- Medial Retropharyngeal

Photos: USDA APHIS VS
Live Animal Testing

- Skin testing (intradermal)
  - Caudal fold test (CFT)
    - Screening test
  - Comparative cervical test (CCT)
    - Confirmatory test

- Blood test
  - Interferon gamma (screening – per State)

Photo: DATCP
CCT scattergraph
United States Bovine Tuberculosis
Affected Herds and Zone Status

TB Status as of September, 2016
- Accredited Free
- Modified Accredited

Herd status shown for 1 year after identification or completion of test-and-remove herd plan, whichever is longer.

[Map showing the affected herds and zone status as of September 2016]
Endemic TB infection in wildlife

- Endemic in wild deer in Northern part of lower MI
  - DNA fingerprints identical all herds
  - ~45 white tail per square mile
  - Only found outside of Michigan
    - 1995 WI heifer (from MI)

- Endemic TB in wildlife
  - Unable to eradicate in livestock
What is the cost of bovine tuberculosis?

- **California**: single cow found + at necropsy
  - > 400,000 cows traced
    - $2 billion
  - Quarantines
    - Restricted animal movement
  - Repeated testing
  - Wildlife in the quarantine area are tested by DNR

- **Texas**
  - 2 dairies infected > 10,000 cows each
TB found in North Dakota dairy heifer

December 05, 2013 4:10 pm

(0) Comments

Related Video

Bovine Tuberculosis Testing, Part 1

BISMARCK – State and federal veterinarians are investigating a case of tuberculosis in a young, non-lactating heifer from an Oliver County dairy herd.

Dr. Susan Keller, the state veterinarian, said the case was found when the owner agreed to have the herd tested after an employee tested positive for Mycobacterium tuberculosis complex.

"U.S. Veterinary Service Laboratory in Ames, IA,
North Dakota Dairy worker with *M. bovis* 2013

- TB test dairy cattle herd
  - 300 head
  - 3 TB Infected Animals
  - 4 Whole herd tests
    - >60 days apart
  - Herd quarantined 1 year
  - Strain typing in human patient and cattle matched
Costs of this disease investigation?

- Department of Agriculture
- Department of Public Health
- Department of Natural Resources
- Farmer
  - Raising steers on facility
  - Cull cows shipped with TB suspects under special permit
  - Product (milk) allowed to move
Making Lemonade from Lemons?

• Lessons learned:
  ▪ Transmission from worker to animals occurs
  ▪ Early Communication between Agencies is critical
  ▪ Educate farmers about risks
    o ND completing brochure for farmers
Key to rapid identification of TB in this herd

• Communication

  o Without information from public health nurse, delay in identifying infection in herd
    ➢ More extensive animal traces
      ❖ $$
    ➢ More opportunity for disease spread to other herds
      ❖ $$
    ❖ Animal losses
    ❖ Potential human exposure
Wisconsin Herd Investigation

- April 29, 2015 DHS notifies DATCP of patient diagnosed with M. bovis
  - Public Health Nurse informs DATCP of interview findings

Demographics/Social History

- Began working on a farm January 2015
  - Working 3rd shift 6pm-6am
    - Fed calves colostrum and assisted with birth
    - Primarily worked alone in a well ventilated area
- Lives with 5 other workers in home farmer provided including 1 son who shared bedroom
- Another son living nearby
DATCP Contacts Herd Owner
April 30, 2015 DATCP interviews dairy owner

- Visit facilities
  - Paperwork
    - Farm specifics
    - Animal movement
  - Herd test prep
    - Equipment
    - Supplies
    - Staff
    - Cow Schedule

- Cattle on Dairy
  - 1100 Adult cows
  - 800 young
  - Animals housed on >1 facility for operation
    - Heifer Raiser
    - Other owners
    - Sell bull calves
What else was arrived in WI in April 2015?
Bovine TB herd test

- **May 15, 2015**
  - 1479 animals tested (injected-caudal fold test)

- **May 18, 2015**
  - 31 responders
  - Herd quarantined
  - Responding animals tested with confirmatory test
    - (injected-comparative cervical)

- **May 21, 2015**
  - 1 suspect on CCT
CCT scattergraph
Herd testing, continued

- May 21, 2015
- Samples collected from suspect for TB
  - Head and neck lymph nodes
  - No gross lesions
- May 26, 2015
  - Histopathology no significant findings

Photo: DATCP
Herd testing, continued

- **May 26, 2015**
  - Herd Quarantine released
  - Herd Plan
    - Official ID
    - Record of animal movements
    - Assurance test 3-6 months
- **July 22, 2015**
  - Culture results from suspect negative
Herd testing, continued

- September 14, 2015
  - 1648 animals tested (injected-caudal fold test)

- September 17, 2015
  - 28 responders
  - Herd quarantined
  - Confirmatory test

- September 21, 2015
  - All negative
  - Quarantine released

Photo: DATCP
The Dairy Industry in WI

- WI dairy industry
  - $43 billion industry
  - Almost 40% of jobs in agriculture sector
  - 9,900 dairy farms
    - Decreasing at rate of 500 farms/year since 1960s
  - 1.28 Million dairy cows
  - 129 Average cow/farms
  - Most WI dairy farms family-owned

Source: Wisconsin Milk Marketing Board
Wisconsin Agricultural Statistics Service
Figure 1: Trends in the Wisconsin Dairy Industry

Figure 2: Estimated Number of Hired Workers On Wisconsin Dairy Farms

http://www.pats.wisc.edu/pubs/98
Increases in Hired workforce on Farms

- 2008 University of Wisconsin Study
  - >12,500 hired employees
  - 40% immigrant workers
  - 88% of immigrant workers from Mexico

http://www.pats.wisc.edu/pubs/98
Current Hurdles to US TB Eradication

- Limitations of detection at slaughter
- Limited animal ID/Traceability at slaughter
- Low sensitivity of testing
- Latent infections in cattle?
- Wildlife infections
- Decreased budgets
Modern practices bring new challenges to disease control

- Movement/mixing of cattle across the country/into country
- Increase in livestock operation size
  - Large heifer raising facilities
    - Mixed animals
    - Fence line contact with feedlot animals
  - Increased hired help
    - Large proportion immigrant labor
    - Often areas with higher prevalence of bovine TB
- Changes pose new opportunities for disease transmission
Summary

• Bovine tuberculosis is a zoonotic and reverse zoonotic disease

• Changing demographics in dairies may increase opportunities for TB transmission between human and animals

• Communication between human and animal health organizations is critical for early identification of TB transmission

• Education and awareness in the farming community is critical
  ■ Opportunity to prevent new infections in people and animals
The End!