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

Elisabeth Patton, DVM, PhD, Diplomate ACVIM
Veterinary Program Manager
Wisconsin Department of Agriculture, Trade and Consumer Protection
Division of Animal Health
Division of Animal Health: Who are we?

- Animal Health Veterinarians
  - Safeguard Animal Health
  - Economic viability
  - Public Health

Photos: WI DATCP
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)
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
  • 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

Adapted from USDA APHIS VS
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

Adapted from USDA APHIS VS
Prevalence of TB per 100,000 people

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

https://www.flickr.com/photos/texaseagle/2730683452
https://en.wikipedia.org/wiki/European_badger
Affected Cattle and Cervid Herds, FY 1987-2014

Average 8 new herds per year
Slaughterhouse Surveillance

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

Photo: USDA APHIS VS
Bovine TB: Necropsy

- Tracheal-Bronchial l.n.
- Medial Retropharyngeal l.n.

Photos: USDA APHIS VS
Live Animal Testing

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

• Blood test
  • Interferon gamma (screening – State approval)
Endemic TB infection in wildlife

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

- Endemic TB in wildlife
- Unable to eradicate in livestock

https://en.wikipedia.org/wiki/Chalco_Hills_Recreation_Area
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

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
- Initial test
  - 3 TB Positive 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
    • ND completing brochure for farmers
Key to rapid identification of TB in this herd

• **Communication**
  
  • 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

- 52 yr old undocumented immigrant from Mexico arriving to U.S. December 2014
- **Farm Worker in WI 2005-2010 in Dane County**
  - Currently working 3rd shift
    - Fed calves colostrum and assisted with birth
    - Primarily worked alone
- 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 happening 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
  - Histopathology and acid fast negative

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

Photo: DATCP
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
The Dairy Industry in WI

- WI dairy industry
  - $26.5 billion industry
  - Almost 50% of total WI Ag $ generated/year
- 10,400 dairy farms in WI
  - Decreasing at rate of 500 farms/year since 1960s
- 86.8% of farms are family-owned
Figure 2: Estimated Number of Hired Workers On Wisconsin Dairy Farms

Farmer Size (Cows)

- 1-300: 4350 Immigrant, 1115 US-born
- 301-600: 1936 Immigrant, 1835 US-born
- 901-1200: 403 Immigrant, 219 US-born
- 1200+: 1091 Immigrant, 457 US-born

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
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
Interagency Communication

Animal Health Agencies

Public Health Agencies

Wildlife Agencies
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 farming community is critical
  • Opportunity to prevent new infections in people and animals
The End!