2019 National Bovine Tuberculosis Eradication Program Update

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SUBCOMMITTEE ON TUBERCULOSIS
Veterinary Services
USDA, APHIS
TOPICS

National Program Status Overview

Update on slaughter surveillance & TB granuloma ID correlation

Update on interferon gamma testing in the U.S.
TB Eradication Status Update
Current TB Eradication Status

United States Tuberculosis Zone Status
Cattle and Bison

TB Status as of October, 2019
- TB Free
- Modified Accredited
All States are Modified Accredited for Captive Cervids
Herds detected in FY2019 & those under quarantine from previous years.
<table>
<thead>
<tr>
<th>Date</th>
<th>State</th>
<th>County</th>
<th>Herd Type</th>
<th>Size</th>
<th>Disclosed By</th>
<th>Herd Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>WI</td>
<td>Dane</td>
<td>Dairy</td>
<td>2,000</td>
<td>Slaughter</td>
<td>Test/Remove</td>
</tr>
<tr>
<td>Oct</td>
<td>MI</td>
<td>Alcona (MAZ*)</td>
<td>Beef</td>
<td>250</td>
<td>Area Surveillance</td>
<td>Test/Remove</td>
</tr>
<tr>
<td>Feb</td>
<td>ND</td>
<td>Sargent</td>
<td>Beef</td>
<td>150</td>
<td>Slaughter</td>
<td>Depopulated</td>
</tr>
<tr>
<td>Feb</td>
<td>TX</td>
<td>Sherman</td>
<td>Organic Dairy</td>
<td>14,000</td>
<td>Epi Trace</td>
<td>Test/Remove**</td>
</tr>
<tr>
<td>Mar</td>
<td>TX</td>
<td>Dallam</td>
<td>Calf ranch</td>
<td>14,500</td>
<td>Epi Trace</td>
<td>Test/Remove</td>
</tr>
<tr>
<td>April</td>
<td>MI</td>
<td>Alpena (MAZ)</td>
<td>Beef</td>
<td>75</td>
<td>Area Surveillance</td>
<td>Test/Remove</td>
</tr>
<tr>
<td>April</td>
<td>MI</td>
<td>Presque Isle (AFZ*)</td>
<td>Beef</td>
<td>16</td>
<td>Area Surveillance</td>
<td>Depopulated</td>
</tr>
<tr>
<td>May</td>
<td>MI</td>
<td>Emmet (AFZ)</td>
<td>Beef</td>
<td>50</td>
<td>Epi Trace from Presque Isle</td>
<td>Test/Remove</td>
</tr>
<tr>
<td>May</td>
<td>NM</td>
<td>Chaves</td>
<td>Dairy</td>
<td>22,000</td>
<td>Slaughter</td>
<td>Test/Remove**</td>
</tr>
<tr>
<td>Aug</td>
<td>TX</td>
<td>Austin</td>
<td>Beef/Rodeo</td>
<td>300</td>
<td>Slaughter</td>
<td>Pending</td>
</tr>
</tbody>
</table>

*MAZ=Modified Accredited Zone
AF=Accredited Free Zone
**Presumed Test/Remove
Cases of Interest
Wisconsin dairy herd

- Cull cow detected at slaughter on September 25, 2018
- Traced back to dairy with Human case of *M. bovis* in dairy worker in 2015
- Herd tested twice at the time - no detections
- WGS of slaughter cow WGS matched human case of 2015 dairy worker
December 2018 ~14,000 head organic dairy complex

Whole herd test due to epi relationship to 2 other previously detected TB-affected herds in Texas

Herd had been tested annually (2015, 2016, 2017) with no detections of TB

December 2018 test found 48 infected animals
The primary genotype is 17B1 (Red Arrow). Recovered from 47 cows/heifers
- First detection in US – 19 SNPs from most common ancestor, detected in Mexico
- Not related to isolates recovered from the 2 epidemiologically related herds in TX (unique)

A second genotype (13A) was identified in a single animal (blue arrow)
- 49 SNPs from any isolate in NVSL database, rooted in Iberian Peninsula
- Not a common genotype found in Mexico
- Indicates a separate introduction to the herd
Cull organic heifers sold to large dairy-calf raiser to be raised as conventional heifers

Mixed with four other consignor dairies

TB detected in the exposed heifer group – direct trace from the affected herd, matching WGS

Due to comingling among different age groups – all heifers in the four consignor dairies considered part of a new herd, ~14,500 head

No further TB detected to date
Ongoing testing of
• heifers as they move back to their home dairy as well as
• home dairy until all original exposed heifers are naturally removed from the herd

Up to 150,000 animals in 10 states in 16 herds impacted at one point – related to the investigation (hold order, quarantine, and/or or will require testing down the road)

Currently ~84,000 animals in 13 herds will be tested in the future; most very low risk & no further TB detected
The incidence of new cases of TB in the US is low, and relatively stable, since 1990.
Number of TB Affected Herds by State FY 2000-2019

158 herds - 62% beef, 30% dairy, 6% captive cervid, 3% mixed
Number of TB Affected Herds by State FY 2000-2019
not including Michigan
In 2009 APHIS increasingly managed TB-affected herds with test-and-remove plans rather than automatically depopulating whole herds. Over time, test-and-remove plans have become the predominant management approach, especially in large dairy herds.

Note: One 2019 herd management plan undecided.
Herd Management by Production Type

**Dairy Herd Management**
- **Dairy - Depopulation**
- **Dairy - Test and Remove**

**Beef Herd Management**
- **Beef - Test and Remove**
- **Beef - Depopulation**
Surveillance
How do we find TB-affected herds? (FY 2000 to 2019)

All States:
- Area testing: 47%
- Epidemiology: 25%
- Routine: 25%
- Slaughter: 3%

All States except MI & MN:
- Area testing: 47%
- Epidemiology: 39%
- Routine: 7%
- Slaughter: 7%
**M. bovis** Positive Cattle from Slaughter Surveillance, FY 2001–2019

1490 total cases including 71 in adult cattle; 419 cases in fed cattle including 313 cases (75%) in Mexican origin fed cattle.
FY 2019 Slaughter Cases

9 Histo-compatible cases
- 8 Confirmed M. bovis cases
- 1 histo+, PCR-, culture pending

4 Adult cattle cases
- 2 ND beef (Affected Herd)
- 1 TX beef (Affected herd)
- 1 SD feedlot

4 Fed cattle cases
- 1 SD feedlot
- 1 MX Chihuahua
- 1 NM dairy heifer (Affected herd)
- 1 NE feedlot
FY 2019
Slaughter Surveillance Cases
ID/Lesion Correlation

9 Histo-compatible cases
- 8 Confirmed *M. bovis* cases
- 1 histo+, PCR-, culture pending

4 Adult cattle cases
- All Matched
- 1 No ID
- 2 ID Match
- 1 No tissue on ID

4 Fed cattle cases
- 1 No ID
- 2 ID Match
- 1 No tissue on ID
<table>
<thead>
<tr>
<th>Year</th>
<th>Histo Comp Cases</th>
<th>No Match (wrong ID)</th>
<th>No Tissue</th>
<th>No ID</th>
<th>PCR (Neg) not M. bovis</th>
<th>Match</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6 (75%)</td>
</tr>
<tr>
<td>2018</td>
<td>14</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>5 (42%)</td>
</tr>
<tr>
<td>2017</td>
<td>15</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>9 (69%)</td>
</tr>
<tr>
<td>2016</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>2015</td>
<td>12</td>
<td>0</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>2014</td>
<td>16</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>2013</td>
<td>29</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>7</td>
<td>12 (55%)</td>
</tr>
<tr>
<td>2012</td>
<td>16</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3 (23%)</td>
</tr>
<tr>
<td>Totals</td>
<td>125</td>
<td>10 (8%)</td>
<td>28 (22%)</td>
<td>14 (14%)</td>
<td>21 (21%)</td>
<td>43 (43%)</td>
</tr>
</tbody>
</table>

Historical Slaughter ID/TB Lesion Correlation
TB Granuloma DNA Matching Program

- VS ongoing program to check the correlation of granulomas submitted to NVSL with their accompanying ID
  - Two granulomas tested per business day that are not histologically compatible (negative) for TB
  - NVSL will continue to test all histo-compatible granulomas
  - All FSIS-inspected plants are included in the program

- VS will work with slaughter plant management to address issues where the:
  - DNA does not match the DNA on the ID
  - No tissue is attached to the tag
  - Animals that were required to have official ID do not
TB Granuloma Submissions and Submission Rate,
FY 2000 – Q3 FY 2019

[Graph showing granuloma submissions and submission rate from FY 2000 to Q3 FY 2019]
Granuloma submissions
Top 40 Adult Cattle Slaughter Plants
Partial Year Data
Live Animal Testing
Caudal Fold Tuberculin Testing (CFT) in Cattle and Bison
FY 2006-2019¹

FY 2019: n=831,883 CFT tests administered in unaffected herds.
Source: Veterinary Services District Offices and SCS database
Mean # per state - 16,247
Median # per state - 5,386

Top 10 States with most-CFTs conducted:
Texas, California, Arizona, Kansas, Colorado, Wisconsin, Indiana, Oklahoma, New Mexico, Pennsylvania
CFT Response Rate by State, Cattle & Bison, FY 2019

Mean 1.1%
Median 1.0%
# Cervid TB Surveillance FY 2019

## Dual Path Platform (DPP) Results

<table>
<thead>
<tr>
<th>Cervid Species</th>
<th>Number of DPP tests</th>
<th>Number of $1^{\text{st}}$ DPP tests non-negative (% response)</th>
<th>Number of $2^{\text{nd}}$ DPP Tests Non-Negative</th>
<th>Necropsy without $2^{\text{nd}}$ DPP test</th>
<th>Negative culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow Deer</td>
<td>647</td>
<td>3 (0.46%)</td>
<td>2</td>
<td>0</td>
<td>1, 1 pending</td>
</tr>
<tr>
<td>Red Deer</td>
<td>28</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>White-tailed Deer</td>
<td>7,378</td>
<td>21 (0.28%)</td>
<td>6</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Elk</td>
<td>2,154</td>
<td>3 (0.14%)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Reindeer</td>
<td>78</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10,285</strong></td>
<td><strong>27 (0.26%)</strong></td>
<td><strong>9</strong></td>
<td><strong>3</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

- Results as of September 30, 2019
- 3 animals pending $2^{\text{nd}}$ test
## Cervid TB Surveillance FY 2019
### Single Cervical Test (SCT) Results

<table>
<thead>
<tr>
<th>Cervid Species</th>
<th>Number of SCT</th>
<th>Number of SCT responders (% response)</th>
<th>Number of CCT Negative</th>
<th>Number of CCT suspect/reactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2,658</td>
<td>41 (1.54%)</td>
<td>41</td>
<td>0</td>
</tr>
</tbody>
</table>

*Results as of September 30, 2019*
# Cervid TB Surveillance FY 2019
## Diagnostic Necropsy

<table>
<thead>
<tr>
<th></th>
<th>Classified DPP Reactor</th>
<th>Necropsy performed</th>
<th>Negative (-) on gross pathology, PCR and histopathology</th>
<th>Culture M.bovis (-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fallow Deer</td>
<td>2</td>
<td>1, 1 pending</td>
<td>1 granuloma</td>
<td>1 (M. kansasii)</td>
</tr>
<tr>
<td>Red Deer</td>
<td>0</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>White-tailed Deer</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Elk</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Reindeer</td>
<td>0</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>12</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: 4 animals necropsied without second DPP test
• Industry requested USDA evaluate the DPP in Mule and Sika
• On October 1, 2018 the Cervid Health Program implemented the DPP for official TB program use in Mule and Sika deer as a pilot project.
• The advantage of the serologic test is that it requires only one capture event; thereby, reducing injury and improving animal welfare
• Industry estimated 30-40% increase in Mule and Sika TB surveillance

• Results for FY 2019

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of DPP test</th>
<th>Suspect/reactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mule</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Sika</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Interferon
Gamma
Testing
Update
Gamma test – a little history

Approved as a supplemental TB test in 2003, cattle only
Primarily used in routine movement testing and replaced CCT – ease of application
Utilized in infected herds to minimize lesions at slaughter
Previously 7 State-level laboratories performing the test plus NVSL

Performance issues noticed in 2014 – many lesioned animals missed in heavily infected herd

Ongoing issues with PPD in Bovigam® kit and various “replacement” PPDs led to withdrawal May 2017
Reinstated in June 2019

• VS evaluated multiple PPDs
• Conducted Sensitivity and Specificity study in 4 infected herds and over 45 presumed negative premises
• Re-released in June 2019 with IDVet PPD, NVSL only approved lab while continue to assess data
• IDVet PPD with Prionics plate
• 0.3 cutoff

Fitted ROC curves of CCT vs. IGRA with 2 PPDs used in 4 infected herds
Data to date since re-released

• Routine testing for movement
  • Limited to 100 samples per week
  • Only Texas submissions at this time
  • Young dairy heifers
  • n=156

• Low positivity rate 0% so far
  • Good specificity – useful for routine testing
Gamma performance in 1 affected herd since June 2019
2\textsuperscript{nd} removal test cows/1\textsuperscript{st} in heifers

<table>
<thead>
<tr>
<th></th>
<th>CFT Injected</th>
<th>CFT Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>9089</td>
<td>491</td>
</tr>
<tr>
<td>Heifers</td>
<td>4395</td>
<td>42</td>
</tr>
<tr>
<td>Total</td>
<td>13484</td>
<td>533</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gamma</th>
<th>Invalids</th>
<th>Testable</th>
<th>&quot;Weak&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gammas</td>
<td>Positive\textsuperscript{a}</td>
</tr>
<tr>
<td>Cows</td>
<td>35</td>
<td>456</td>
<td>1</td>
</tr>
<tr>
<td>Heifers</td>
<td>4</td>
<td>38</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>494</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CCT\textsuperscript{c}</th>
<th>CCT (N)</th>
<th>CCT (S)\textsuperscript{d}</th>
<th>CCT (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>432</td>
<td>46</td>
<td>11</td>
</tr>
<tr>
<td>Heifers</td>
<td>41</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>473</td>
<td>47</td>
<td>11</td>
</tr>
</tbody>
</table>

a. Gamma positive was CCT (N)
b. Gamma=0.182, close to cutoff of 0.2 and the animal was CCT (R)
c. 2 CCTs not conducted: 1 died, 1 missed
d. One CCT (S) was gamma negative
Ongoing analysis

- Continue gathering data

- TB Scientific Advisory Workgroup to further analyze
Collaborations with Mexico

- Regular meetings of VS and SENASICA
  - Fed-Fed
  - BNC
  - 2019-2024 US-MX TB Strategic Plan
- Closure of 2013-2018 US-MX Strategic Plan ‘Summaries of Progress’ was finalized (pending review & clearance)
- 2019-2024 US-MX Strategic Plan finalized (pending review & clearance)
- APHIS participated in pre-certification reviews in four Mexican States
- APHIS Conducted State TB Program Reviews
  - Sinaloa, Zacatecas, Jalisco, Puebla
  - Final decisions on technical team recommendations still pending

Map courtesy of SAGARPA
Thank you

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SUBCOMMITTEE ON TUBERCULOSIS
Veterinary Services
USDA, APHIS

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