BRDC: A review of pathology and antibiotic susceptibility trends

Jeremy Schefers DVM PhD
Minnesota Veterinary Diagnostic Laboratory
Acute, fibrinous pleuropneumonia, *Mannheimia hemolytica*

Fluid and fibrin in the chest is *Mannheimia hemolytic* until proven otherwise.

Tissue damage is a result of leukotoxin. Neutrophils that are recruited to phagocytize bacteria are killed by leukotoxin prior to buffering peroxides.
Acute Mannheimia hemolytica pleuropneumonia in a dairy cow
More acute *Mannheimia hemolytica* pleuropneumonia in a dairy cow

Black lung is pulmonary necrosis (dead lung).

About 2 gallons of yellow fluid (serum) ran out when the chest was opened.
Beef heifer BRDC

• Mid December 2016, bitter cold weather
• Yearling heifers in estrus became “sweated up.”
• *M. hemolytica* pleuropneumonia.
• BRSV IHC positive
Cattle have a tough time transitioning into, and out of, winter. **Cool & wet environment is a driver**

- **Summer** = Warm +/- dry
- **Fall** = Cool +/- wet
- **Winter**: Cold, but drier as moisture is froze out of the air.
- **Early spring**: Cool, but WET, SLOPPY, FOGGY

*Dust to the graph*

**Mannheimia hemolytica** pneumonia (by month)
Chronic, abscessing bronchopneumonia
*Pasteurella, Histophilus somni, Trueperella pyogenes*

The lack of fibrin and fluid tentatively excludes *Mannheimia hemolytica* as a co-infecter.

Abscesses take about 3 weeks to form, so this lesion can be “time stamped” older than 3 weeks old.
Chronic, abscessing bronchopneumonia
*Pasteurella, Histophilus somni, Trueperella pyogenes*

This calf was also persistently infected with BVDV (BVDV – PI).

There were no gross lesions of BVDV mucosal disease.
Histopathology: Endobronchial polyp
Chronic *Histophilus somni* infection

Polyps are permanent
Histopathology: Brochiolitis obliterans

*Pasteurella multocida*

**Early:** Peroxides from degenerating neutrophils relax bronchiolar smooth muscle and expand airway (pus plug)

**Late:** Abscessation with complete loss of bronchiolar architecture. All “downstream lung” in lost.
250 lb. calf that died of chronic abscessing pneumonia
Calf lung

• Calf weighed 250 lbs.
• Lungs weighed 8.5 lbs.
• Healthy lung = 2 lbs.
• The lung of this calf contained 6 lbs. of pus and scar tissue.
• Adult cattle can easily have 30-40 pounds of inflammation (pus) and scar tissue replacing their lungs.
Collateral damage: Chronic bloat from a inflammed vagus nerve
Microscopic picture of abscess

Normal, healthy lung

Thick WALL of scar tissue

Pus & bacteria

Antibiotics don’t penetrate scar tissue
Aspiration pneumonia

• Unilateral, right-sided pulmonary consolidation is a feature of aspiration pneumonia.

• Often seen in calves that destroy nipple tips on automated calf feeders and calves that are improperly tube-fed.

Dorsal view of 2-month-old calf lung
Aspiration pneumonia = Unilateral consolidation

This is lung from a 2-month-old Holstein dairy calf. For reasons I can’t fully explain, about 1/3 of calves develop this lesion after being tube fed colostrum. Affected calves develop a fever between 8 - 10 days of age. Treatment was unrewarding. Unfortunately, the abscess is permanent.
Aspiration:
Unilateral, right-sided pneumonia

The bovine trachea has a branch on the right side before the bifurcation at the level of the heart.

Fluid accumulates in the right lung lobes before it accumulates in the right caudal or left lung lobes.
Remind feeders that the nose should be lower than the eye to allow regurgitated milk to flow OUT THE MOUTH AND NOT DOWN THE LUNG.
Bacterial pneumonia trends

BRDC isolate trends 2005 - 2016

Number of isolates


P. multocida
H. somni
M. hemolytica
Bacterial pneumonia trends

![Number of isolates by year](image-url)
• Mycoplasma: There are no approved *in vitro* methods or cut-points established for *Mycoplasma spp.* susceptibility testing.

• MIC cut-points have recently been determined for gamithromycin (Zactran) and tildipirosin (Zuprevo), but are not included here.

• The susceptibility cut-point for CTC in this material was lowered from >2 to <2 to reflect new CTC PK/PD data. (Reinbold *et al.*, Journal of Veterinary Pharmacology and Therapeutics, 2009).

- **Chlortetracycline**
- **Tilmicosin**
- **Tulathromycin**
- **Florfenicol**
- **Enrofloxacin**

The graph shows the percentage of resistant isolates over the years from 2005 to 2016. The number of isolates per year is indicated in parentheses next to the year. The trend line indicates an increasing resistance rate for Chlortetracycline over the years.
Resistance trends of non-lactating antibiotics to *Mannheimia hemolytica* (2005 – 16)

![Graph showing resistance trends of non-lactating antibiotics to *Mannheimia hemolytica* from 2005 to 2016. The graph compares the percent resistant of Chlortetracycline, Tilmicosin, Enrofloxacin, Tulathromycin, and Florfenicol over the years. Chlortetracycline shows a notable increase from 13% in 2006 to 38% in 2016.](image)

- **Sulphadimethoxine**: 74%
- **Oxytetracycline**: 47%
- **Ampicillin**: 7%
- **Ceftiofur**: 0%

YEAR (Number of Isolates):

- 2005 (69)
- 2006 (108)
- 2007 (118)
- 2008 (70)
- 2009 (52)
- 2010 (92)
- 2011 (101)
- 2012 (69)
- 2013 (88)
- 2014 (78)
- 2015 (78)
- 2016 (90)
Resistance trends of lactating antibiotics to *Mannheimia hemolytica* (2006 – 16)

- **Sulphadimethoxine**: 77%
- **Penicillin**: 37%
- **Ampicillin**: 16%
- **Oxytetracycline**:
- **Ceftiofur**: Linear (Ampicillin)
Resistance trends of CTC and OTC to BRDC pathogens 2005 - 2016
**Bacterial susceptibilities vary by farm**

<table>
<thead>
<tr>
<th></th>
<th>Sale barn</th>
<th>Farm 2: Holstein calves</th>
<th>Farm 3: Angus calves</th>
<th>Farm 4: Holstein steers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Angus feeders</strong></td>
<td><strong>Histophilus somni</strong></td>
<td><strong>H. somni</strong></td>
<td><strong>P. mult</strong></td>
<td><strong>P. mult</strong></td>
</tr>
<tr>
<td><strong>Polyflex</strong></td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Susceptible</td>
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<tr>
<td><strong>Excenel/Excede</strong></td>
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<td>Susceptible</td>
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<tr>
<td><strong>Chlortet (CTC)</strong></td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Susceptible</td>
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<tr>
<td><strong>Baytril</strong></td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Resistant</td>
<td>Resistant</td>
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<tr>
<td><strong>Nuflor</strong></td>
<td>Resistant</td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Susceptible</td>
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<tr>
<td><strong>Oxytet</strong></td>
<td>Resistant</td>
<td>Susceptible</td>
<td>Susceptible</td>
<td><strong>Resistant</strong></td>
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<td><strong>Sulfa</strong></td>
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<td><strong>Resistant</strong></td>
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<tr>
<td><strong>Micotil</strong></td>
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<td>Susceptible</td>
<td>Resistant</td>
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<tr>
<td><strong>Draxxin</strong></td>
<td>Resistant</td>
<td>Susceptible</td>
<td>Susceptible</td>
<td>Resistant</td>
</tr>
</tbody>
</table>
Salmonella dublin infections in dairy cattle
Gross images: Icterus and splenomegaly
More Icterus and Hepatomegally
Diffuse interstitial pneumonia and serofibrinous pleuritis
Most Common Salmonella Serotypes
Trends 2005 - 2010

Number of positive cultures

Years

Dublin
Montevideo
Newport
Typhimurium
Age Distribution of \textit{S. dublin} cases

Age class distribution of Salmonella dublin cases  
(n = 45, 2012 – 2013)
$S. \ dublin$ antibiotic susceptibilities

*Salmonella dublin in vitro* antibiotic susceptibilities.

(42 isolates, 2012 – 2013)
Negative energy balance appears to trigger many cases of *S. dublin*.

Me to farmer: 
*Do I need to draw you a picture?*

*Here is the picture.*
Intestinal *E. coli* isolates and antibiotic options...or lack thereof.
Neomycin considerations

• Neomycin levels in the intestines can reach $>150 \text{ ug/ml}$ when fed at 1 gram / 100 lbs (legal limit per label).

• The “resistant” cut point for Neomycin in the MIC machine is $32 \text{ ug/ml}$, so Neomycin levels fed at 1 gram/100 lbs may still be somewhat effective in the gut lumen at levels higher than what the MIC machine says it's "resistant."

• Usually, we don’t have to have the antibiotic discussion if we fix the Rotavirus, Coronavirus and Cryptosporidiosis problems.
Summary

• Trends in bacterial pneumonia remain constant.
• Resistance to the tetracyclines appear to be rising.
• Resistance to most prescription antibiotics do not appear to be happening.
• Antibiotic options for *Salmonella dublin* and *E. coli* remain limited.