Feedlot Receiving Calf Health & Well-Being Conference: Ancillary Therapeutics

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Outline

- Introduction
  - The problem
    - Why do we see widespread use of ancillary therapy (ANC)?
  - What is ANC?
- ANC use in feedlots
- Survey data
- Wilson et al., 2015
- Other recent research
- ANC reviews
- Conclusions
- Questions
Introduction

- Bovine respiratory disease (BRD)
  - Most significant production problem confronting the feedlot industry
  - Accounts for the majority of morbidity, mortality, and production losses
    - 70 to 80% of all morbidity and 40 to 50% of all mortality (Hilton, 2014)
  - Estimated annual economic losses due to BRD ≥ $2 billion (Powell, 2013)
    - Death loss, decrease performance, and treatment cost
    - Does not include money spent on prevention, lost carcass value, labor, etc.
  - Extremely complicated illness and a multitude of stressors, viruses, and bacterial pathogens can potentially contribute to its onset (Duff and Galyean, 2007)

Introduction

- Pathogenesis of BRD
  - Typically involves compromised respiratory immune mechanisms
    - Risk factors or stressors
      - Pre-marketing stressors
      - Stressors associated with the cattle marketing process
      - Post-marketing stressors
  - BRD manifests itself in the stocker or feedlot segments of the beef industry
    - Often not where the problem is initiated
Introduction

- BRD pathogenesis is well documented, but complicated
  - Primary infection with one or more respiratory viruses
    - Viral infection and the impaired immune response
    - Further compromise the immune system
    - Allow for the colonization of lung tissues by bacteria

- Many BRD pathogens are frequently isolated from clinically healthy cattle
  - Most common bacterial pathogen isolated from calves treated for BRD
    - *Mannheimia haemolytica* (MH) (Whitley et al., 1992; Booker et al., 2008)
    - Also frequently isolated from the respiratory tract of healthy calves (Klima et al., 2014)

Introduction

- Principal viral pathogens associated with BRD
  - Bovine herpesvirus 1 (BHV1)
    - Leads to infectious bovine rhinotracheitis (IBR)
  - Bovine viral diarrhea virus (BVDV) Type I and II
  - Parainfluenza virus type 3 (PI3)
  - Bovine respiratory syncytial virus (BRSV)

- Principal bacterial pathogens associated with BRD
  - *Mannheimia haemolytica* (MH)
  - *Pasteurella multocida* (PM)
  - *Histophilus somni* (HS)
  - *Mycoplasma bovis* (MB)
Introduction

- Prevention and treatment of BRD (NAHMS, 2013)
  - Preconditioning

- Most feedlots vaccinate
  - BVDV (96.6% of feedlots)
  - IBR (93.7% of feedlots)
  - BRSV (89.5% of feedlots)
  - PI3 (85.1% of feedlots)
  - Bacterial pathogens (~50% of feedlots)

- Treatment protocols for BRD vary greatly from feedlot to feedlot
  - Standard practice is to administer some class of injectable antimicrobial
  - 99.0% used an injectable antimicrobial as the primary treatment for BRD

Introduction

- Gained considerable knowledge about BRD
  - Pathogenesis
  - Advancements in vaccine technology
  - Advancements in antimicrobial production

- However, the prevalence of BRD has not been significantly reduced
  - Data indicates that no significant reduction in last 30 to 40 years
    - Gifford et al., 2012; Hilton, 2014

- Could be argued that current BRD prevention and treatment strategies
  - Ineffective in reducing and controlling BRD

- Other therapies and treatments have been investigated
  - Attempt to improve the response of calves treated for BRD
Introduction

- Ancillary Therapy (ANC)
  - Additional form of treatment in combination with an antimicrobial
  - Majority of feedlots use some form of ANC

- Primary goal of ANC
  - Improve the calf’s response to a BRD challenge
  - Not to replace antimicrobial treatment

- Ultimately, ANC characteristically focuses on the calf or the calf’s symptoms
  - Not on the invading pathogens
  - Vaccines would be one of the few exceptions

Introduction

- Improvement in the calf’s response to BRD
  - Accomplished through a variety of mechanisms

- Can be divided into 3 broad classes (Apley, 1994)
  - Relieve the harmful effects of inflammation
    - Corticosteroids and non-steroidal-anti-inflammatory-drugs (NSAID)
  - Block histamine activity
    - Antihistamines
  - Or boost immune system function to aid in the defense of infectious pathogens
    - Vitamins, minerals, direct-fed microbials (DFM), and vaccines
Introduction

- ANC use in feedlots
  - Surveys of veterinarians or feedlot operators
    - (NAHMS, 2001; Terrell et al., 2011; NAHMS, 2013*)
  - Most commonly utilized ANC occur with great repeatability
  - Frequency of utilization varies over time and among the different surveys
  - Across all surveys the most commonly utilized forms of ANC include
    - Antihistamines
    - B vitamins
    - Corticosteroids
    - DFM
    - NSAID
    - Viral vaccines
    - Vitamin C

Feedlot 2011
Part IV: Health and Health Management on U.S. Feedlots with a Capacity of 1,000 or More Head

<table>
<thead>
<tr>
<th>Ancillary therapy</th>
<th>Percentage of all feedlots</th>
<th>Percentage of all cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antihistamines</td>
<td>16.7%</td>
<td>5.4%</td>
</tr>
<tr>
<td>B vitamins</td>
<td>16.8%</td>
<td>5.4%</td>
</tr>
<tr>
<td>Corticosteroids</td>
<td>30.9%</td>
<td>10.1%</td>
</tr>
<tr>
<td>DFM</td>
<td>18.2%</td>
<td>6.7%</td>
</tr>
<tr>
<td>NSAID</td>
<td>55.9%</td>
<td>19.6%</td>
</tr>
<tr>
<td>Viral vaccines</td>
<td>39.3%</td>
<td>48.5%</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>7.8%</td>
<td>34.1%</td>
</tr>
</tbody>
</table>
Introduction

➢ Surveys

➢ Provide evidence to the frequency of ANC use in feedlots
➢ No information on the modes of action of ANC
➢ No evidence as to the efficacy of ANC use
➢ Very few reviews of ANC utilization have been conducted
➢ Limited published research concerning the efficacy of ANC use
➢ Results are highly inconsistent

Wilson et al., 2015

Evaluation of multiple ancillary therapies used in combination with an antimicrobial in newly received high-risk calves treated for bovine respiratory disease

➢ Objective
➢ Evaluate the effects of 3 commonly used ANC in combination with an antimicrobial in newly received high-risk calves treated for BRD
Materials and Methods

- **Animals**
  - 516 crossbred steers and bulls (BW at arrival = 217 ± 20 kg)
  - Purchased over the course of 1 week from Oklahoma livestock auctions
  - Transported (average distance = 135 km) to WSBRC

- **Upon arrival at the feed yard**
  - Individual BW obtained
  - Tagged
  - Visually inspected for noticeable deformities
  - Hide color, horn status, and sex was recorded

- Calves were commingled into receiving pens
  - Given ad libitum access to prairie hay and water
  - Allowed to rest 24 to 48 h prior to initial processing

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Materials and Methods

- **Initial processing**
  - BRD Shield; Elanco, Greenfield, IN
  - IBR, BVDV Type 1 and 2, PI3, and BRSV
  - Caliber 7; Boehringer-Ingelheim, St. Joseph, MO
    - *Clostridium chauvoei, Clostridium septicum, Clostridium novyi, Clostridium sordelli*, and *Clostridium perfringens* Types C and D
  - Ivomec Plus; Merial, Duluth, GA

  - Individual BW were obtained
  - Bulls (n = 355) were surgically castrated
  - Horns (n = 57) were tipped
Materials and Methods

- Calves were visually monitored twice daily by trained evaluators
- Modified DART system; Zoetis, Florham Park, NJ
- Subjective criteria
  - Depression, abnormal appetite, and respiratory signs
  - Assigned a clinical severity score (CS) from 0 to 4 based on clinical signs
    - Score of 0 = a clinically normal appearing calf
    - Score of 1 = mild clinical signs
    - Score of 2 = moderate clinical signs
    - Score of 3 = severe clinical signs
    - Score of 4 = a moribund animal
  - Calf was unable to rise, or had extreme difficulty standing, walking, or breathing
- Objective criteria
  - Rectal temperature (TEMP)

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Materials and Methods

- All calves assigned a CS of 1 to 4 were pulled
- Calves received antimicrobial via 2 protocols
  - Pulled with a CS of 1 or 2 and a TEMP of 40°C (104°F) or greater
  - Pulled with severe clinical signs (CS = 3 or 4) regardless of TEMP
- Calves pulled with a CS of 1 or 2 having a TEMP of less than 40°C
  - No antimicrobial was administered
  - No ANC was administered
- Calf was returned to its original receiving pen after evaluation
Materials and Methods

- Calves that met criteria and received an antimicrobial for BRD
  - Randomly assigned to 1 of 4 experimental ANC treatments
    - 320 hd enrolled (80 hd/ANC)

- Experimental ANC treatments
  - Intravenous flunixin meglumine injection (NSAID)
  - Intranasal viral vaccination (VACC)
  - Intramuscular vitamin C injection (VITC)
  - No ANC (NOANC)

- ANC were given at all subsequent BRD treatments

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Materials and Methods

- VITC experimental treatment
  - 10 mL per calf of Vita-Jec® C (Aspen; Liberty, MO)
    - 250 mg of sodium ascorbate per mL (injected intramuscularly)

- NSAID experimental treatment
  - 2 mL per 45.4 kg of BW of Suppressor® (RXVeterinary; Westlake, TX)
    - 50 mg of flunixin per mL (injected intravenously)

- VACC experimental treatment
  - 2 mL per calf of Inforce 3® (Zoetis; Florham Park, NJ)
    - IBR-PI3-BRSV viral vaccine (administered intranasally)

- NOANC experimental treatment
  - Only an antimicrobial was administered
    - No ANC
Materials and Methods

➢ Each time a calf was pulled for potential BRD treatment
➢ CS, BW, and TEMP were recorded
➢ Individual BW were obtained for all animals on d 28 and d 56
➢ Data analysis was completed using the MIXED procedure of SAS
➢ SAS 9.3; SAS Institute Inc., Cary, NC
➢ Animal or Pen served as the experimental unit
➢ Pen average values were calculated using individual DOF for each animal
➢ Calculated both deads in and deads out performance
➢ Mortalities and removals were backed out at calculated maintenance intake
➢ NEm= 0.077 Mcal/EBW^{0.75}

Results

Table 1. Effects of ancillary therapies used in combination with an antimicrobial on performance of calves treated for bovine respiratory disease

<table>
<thead>
<tr>
<th>Experimental ancillary treatment¹</th>
<th>NOANC</th>
<th>NSAID</th>
<th>VACC</th>
<th>VITC</th>
<th>Pooled SEM³</th>
<th>P-value²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pens</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Total head enrolled</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment BW⁴, kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment</td>
<td>215</td>
<td>214</td>
<td>212</td>
<td>213</td>
<td>3.32</td>
<td>0.78</td>
</tr>
<tr>
<td>2nd treatment</td>
<td>214</td>
<td>209</td>
<td>212</td>
<td>212</td>
<td>6.97</td>
<td>0.82</td>
</tr>
<tr>
<td>3rd treatment</td>
<td>211ᵃ</td>
<td>192ᵇ</td>
<td>192ᵇ</td>
<td>192ᵇ</td>
<td>5.63</td>
<td>0.01</td>
</tr>
<tr>
<td>4th treatment</td>
<td>193</td>
<td>181</td>
<td>190</td>
<td>194</td>
<td>12.1</td>
<td>0.60</td>
</tr>
<tr>
<td>Average daily gain⁵, kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st to 2nd</td>
<td>-0.54</td>
<td>-0.48</td>
<td>-0.61</td>
<td>-1.01</td>
<td>0.40</td>
<td>0.63</td>
</tr>
<tr>
<td>2nd to 3rd</td>
<td>-0.13ᵃ</td>
<td>-1.3⁰ᵇ</td>
<td>-1.9⁰ᵇ</td>
<td>-1.41ᵇ</td>
<td>0.42</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>3rd to 4th</td>
<td>-0.31</td>
<td>-0.28</td>
<td>-0.48</td>
<td>-0.45</td>
<td>0.72</td>
<td>0.99</td>
</tr>
<tr>
<td>1st to 4th</td>
<td>-0.89</td>
<td>-0.97</td>
<td>-1.16</td>
<td>-1.01</td>
<td>0.34</td>
<td>0.94</td>
</tr>
</tbody>
</table>
## Results

### Table 2. Effects of ancillary therapies used in combination with an antimicrobial on retreatment percentages and retreatment intervals of calves treated for bovine respiratory disease

<table>
<thead>
<tr>
<th>Experimental ancillary treatment¹</th>
<th>Pooled SEM²</th>
<th>P-value²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total head enrolled</td>
<td>80 80 80 80</td>
<td></td>
</tr>
<tr>
<td>Retreatments⁴, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd treatment</td>
<td>48.8 51.3 37.5 43.8 11.4 0.26</td>
<td></td>
</tr>
<tr>
<td>3rd treatment</td>
<td>55.1 42.7 50.4 44.7 13.5 0.67</td>
<td></td>
</tr>
<tr>
<td>4th treatment</td>
<td>29.7xy 35.7yz 59.2xz 67.2hz 12.1 0.05</td>
<td></td>
</tr>
<tr>
<td>3rd treatment of 1st</td>
<td>30.0 25.0 21.3 22.5 9.63 0.54</td>
<td></td>
</tr>
<tr>
<td>4th treatment of 1st</td>
<td>8.75 8.75 12.5 15.0 5.48 0.50</td>
<td></td>
</tr>
<tr>
<td>Time to treatment⁵, d</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment</td>
<td>7.53 7.28 7.30 7.27 1.36 0.82</td>
<td></td>
</tr>
<tr>
<td>2nd treatment</td>
<td>19.4 16.7 18.0 16.9 3.34 0.31</td>
<td></td>
</tr>
<tr>
<td>3rd treatment</td>
<td>26.4a 18.2b 18.3b 17.9b 2.22 &lt;0.001</td>
<td></td>
</tr>
<tr>
<td>4th treatment</td>
<td>31.0 26.7 24.7 25.8 2.66 0.30</td>
<td></td>
</tr>
</tbody>
</table>

### Table 3. Effects of ancillary therapies used in combination with an antimicrobial on clinical severity scores, rectal temperatures, and mortalities and removals

<table>
<thead>
<tr>
<th>Experimental ancillary treatment¹</th>
<th>Pooled SEM²</th>
<th>P-value²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pens</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total head enrolled</td>
<td>80 80 80 80</td>
<td></td>
</tr>
<tr>
<td>Severity score⁴</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment</td>
<td>1.14ax 1.13ax 1.04by 1.18a 0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>2nd treatment</td>
<td>2.37a 2.83c 2.53ab 2.69bc 0.27</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>3rd treatment</td>
<td>2.50a 2.84b 2.98b 3.11b 0.23</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>4th treatment</td>
<td>2.84 3.05 2.99 2.83 0.30</td>
<td>0.72</td>
</tr>
<tr>
<td>Rectal temperature⁵, °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment</td>
<td>40.7 40.7 40.8 40.8 0.08</td>
<td>0.27</td>
</tr>
<tr>
<td>2nd treatment</td>
<td>40.3 40.3 40.5 40.3 0.19</td>
<td>0.87</td>
</tr>
<tr>
<td>3rd treatment</td>
<td>39.6 39.4 39.4 39.4 0.33</td>
<td>0.86</td>
</tr>
<tr>
<td>4th treatment</td>
<td>39.5 39.4 39.0 39.1 0.31</td>
<td>0.55</td>
</tr>
<tr>
<td>Mortality and removals, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality⁶</td>
<td>17.5 22.5 20.0 23.8 8.97</td>
<td>0.74</td>
</tr>
<tr>
<td>Off trial and removals⁷</td>
<td>6.17a 0.00b 3.65ab 1.16b 1.92</td>
<td>0.08</td>
</tr>
</tbody>
</table>
Results

Table 4. Effects of ancillary therapies used in combination with an antimicrobial on receiving performance with mortalities and removals excluded

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental ancillary treatment&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Pooled SEM&lt;sup&gt;1&lt;/sup&gt;</th>
<th>P-value&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOANC</td>
<td>NSAID</td>
<td>VACC</td>
</tr>
<tr>
<td>Pens</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Total head enrolled</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>Body weight&lt;sup&gt;4&lt;/sup&gt;, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment</td>
<td>216</td>
<td>214</td>
<td>212</td>
</tr>
<tr>
<td>d 28</td>
<td>253</td>
<td>246</td>
<td>245</td>
</tr>
<tr>
<td>d 56</td>
<td>290</td>
<td>281</td>
<td>282</td>
</tr>
<tr>
<td>Average daily gain&lt;sup&gt;5&lt;/sup&gt;, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment – d 28</td>
<td>1.30</td>
<td>1.11</td>
<td>1.17</td>
</tr>
<tr>
<td>d 28 – d 56</td>
<td>1.30</td>
<td>1.25</td>
<td>1.32</td>
</tr>
<tr>
<td>d 56</td>
<td>1.29</td>
<td>1.16</td>
<td>1.23</td>
</tr>
<tr>
<td>Dry matter intake&lt;sup&gt;6&lt;/sup&gt;, kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment – d 28</td>
<td>5.43</td>
<td>4.76</td>
<td>5.04</td>
</tr>
<tr>
<td>d 28 – d 56</td>
<td>8.05</td>
<td>7.37</td>
<td>7.58</td>
</tr>
<tr>
<td>d 56</td>
<td>6.70</td>
<td>6.03</td>
<td>6.28</td>
</tr>
<tr>
<td>Gain:Feed&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st treatment – d 28</td>
<td>0.238</td>
<td>0.245</td>
<td>0.233</td>
</tr>
<tr>
<td>d 28 – d 56</td>
<td>0.155</td>
<td>0.164</td>
<td>0.167</td>
</tr>
</tbody>
</table>

Summary and Implications

- NOANC
  - Increased BW when receiving 3<sup>rd</sup> antimicrobial for BRD
  - Increased (decreased decrease) ADG between 2<sup>nd</sup> and 3<sup>rd</sup> antimicrobials
  - Fewer 4<sup>th</sup> antimicrobials administered than VACC or VITC
  - Increased DOF before receiving 3<sup>rd</sup> antimicrobial for BRD
  - Decreased CS when receiving 2<sup>nd</sup> and 3<sup>rd</sup> antimicrobial for BRD
  - No differences in performance among any ANC
  - Numerical increase in ADG and DMI for NOANC
Summary and Implications

- Widespread use of ANC within the feedlot industry
- Limited published research on efficacy
- This experiment compared 3 different ANC
  - Most commonly used according to survey data
  - Different in intended effects and modes of action
  - Across common population of calves treated for BRD
- Calves experienced a significant natural immune challenge
  - First treatment morbidity of 66.5%
  - Mortality attributed to BRD of 13.2%
  - May have limited the ability to respond to the 3 ANC

Responses to the 3 ANC were negligible
- Both receiving and finishing periods
- ANC in calves treated for BRD
  - An unnecessary expense
  - No benefit to calf health or performance
  - Does not appear to be warranted

ANC use could potentially have negative effects on calf performance during the receiving period if administered to calves experiencing a severe natural immune challenge
Other Data (2014-2016)

- Crews et al., 2014 (n ≈ 35/trt)
  - Antimicrobial with or without isoflupredone acetate
  - Antimicrobial treated calves that exhibited signs of clinical BRD
  - Increased neutrophils and decreased lymphocytes with SAID administration
  - Greater neutrophil:lymphocyte
  - ADG tended to be increased from d 14 to 28 with SAID administration
  - No difference in overall ADG
  - SAID did not reduce medical treatment costs or repeat treatments

- Plessers et al., 2015 (n = 6/trt)
  - LPS challenge with or without antimicrobial and dexamethasone
  - No prominent changes in breathing or febrile response with corticosteroid
  - Corticosteroid inhibited TNF-α and IL-6
  - Calves receiving corticosteroid recovered faster
  - Authors suggested improved animal welfare

Other Data (2014-2016)

- Toaff-Rosenstein et al., 2016 (n = 2-5/trt)
  - Challenge with BRSV and H. somni or not with or without meloxicam
  - Primarily a behavioral experiment
  - No effects of NSAID administration

- Walsh et al., 2015 (n = 8/trt)
  - Induced BRSV infection with or without ibuprofen
  - Primarily concerned with the adverse effects of repeated NSAID administration
  - Increased prevalence of abomasal ulceration (5 vs. 2; NS) with NSAID administration
  - One case of mild interstitial nephritis with NSAID administration
Ancillary Therapy Reviews

- Appley, 1994
  - “Ancillary therapy for bovine respiratory disease”
  - Excellent review of the modes of action of various ANC

- Appley, 2010
  - “Ancillary therapy of respiratory disease in food animals: What can we give in addition to an antibiotic?”
    - Focused primarily on AID
    - Concluded NSAID have some beneficial effects
      - Reduction in rectal temperature
      - Other clinical responses were inconsistent
    - No justification for VACC, VITC, or other ANC

Ancillary Therapy Reviews

- Francozet et al., 2012
  - “Evidence related to the use of ancillary drugs in bovine respiratory disease (anti-inflammatory and others): Are they justified or not?”
    - Excellent review of ANC
    - Experiments must have involved the treatment of naturally occurring BRD
    - With antimicrobials and with and without at least 1 ANC
    - 15 manuscripts met the criteria
      - 14 dealt with AID
        - 12 NSAID experiments, 1 SAID experiment, and 1 experiment with both
        - 1 experiment with immune-modulators
Ancillary Therapy Reviews

- Francozet al., 2012
  - NSAID (flunixin meglumine)
  - Decreased rectal temperatures and the potential for decreased lung consolidation/lesions
  - May be important from an animal welfare perspective
  - No consistent benefit on clinical signs, mortality, or performance
  - Difficult to determine an economic benefit for use due to inconsistent results
  - No published data supported the use of VACC, VITC, or other ANC for BRD

- DeDonder and Appley, 2015
  - Same search criteria as Francozet al. (2012)
  - Unable to identify any recent publications of relevance to expand that review

Conclusions

- Does not appear to be justification for the use of ANC for BRD
- Wilson et al., 2015
- Francozet al., 2012

- However, based on numerous surveys...
  - Feedlots are using ANC
  - Proprietary data?
  - Emotional decision?
  - Doing anything is better than doing nothing? What could it hurt?
  - May not be the case
Conclusions

- NSAID
  - Reduce fever
  - Short term effect
  - What is this accomplishing?
  - Other research/responses to are inconsistent at best

- ANC outside of NSAID
  - Lack of research
  - Need for larger, replicated experiments
  - Difficult to run, labor intensive, cost vs. benefit

Questions?