



# PorkFACTS™

AN UPDATE OF RECENT SWINE RESEARCH

## Comparison of Aureomycin® and Lincomix® for Decreasing the Potentiation of PRRSV Pneumonia by *Mycoplasma hyopneumoniae*

### ► SUMMARY

A controlled university study compared the impact of Aureomycin® or Lincomix® on the potentiation of PRRSV-induced pneumonia by *Mycoplasma hyopneumoniae* (*M. hyo*). The study involved 112 weanling barrows that were challenged with PRRSV, *M. hyo*, or both pathogens, and fed rations containing Aureomycin (10 mg/lb body weight/day for 14 days), Lincomix (200 g/t for 21 days), or nonmedicated. Pigs treated with Aureomycin demonstrated significant improvements in multiple performance and disease-associated parameters compared to animals medicated with Lincomix (daily gains, coughing, febrile days, pneumonic lung lesions, pathogen recovery from lungs, and serology). The severity and duration of *M. hyo*-potentiated PRRSV pneumonia was significantly moderated by Aureomycin compared to Lincomix. Study results also demonstrated that Aureomycin is a valuable tool for controlling mycoplasmal pneumonia, particularly in pigs also infected with PRRSV.

**Aureomycin is a valuable production tool that reduces the ability of *M. hyo* to potentiate PRRSV pneumonia.**

### ► RATIONALE

- *Mycoplasma hyopneumoniae* has been documented to increase the severity and duration of pneumonia induced by porcine reproductive and respiratory syndrome virus (PRRSV) and is recognized as an important pathogen in triggering porcine respiratory disease complex (PRDC).<sup>1</sup>
- Aureomycin® is the premier granulated chlortetracycline feed-additive premix that optimizes the amount of drug that is delivered to the gut and available for systemic distribution throughout the body of swine. Aureomycin is approved for high-level therapeutic use (10 mg/lb body weight/day for up to 14 days) for treatment of swine bacterial pneumonia caused by *Pasteurella multocida*.
- Although Aureomycin is not approved for control of *M. hyo*-associated disease, previous research has demonstrated:
  - Aureomycin administration in the feed starting prior to experimental challenge with *M. hyo* significantly decreased both the severity of pneumonia and the number of organisms in infected pigs;<sup>2</sup>
  - Aureomycin decreased *M. hyo* potentiation of PRRSV-induced disease in a co-infection model.<sup>3</sup>

## ▶ RATIONALE (CONT.)

- Lincomix® is currently the only feedgrade antibiotic approved for *M. hyo* (reduction in severity of mycoplasmal pneumonia when fed at 200 g/t for 21 days).
- A study was recently conducted to evaluate the impact of Aureomycin or Lincomix on *M. hyo* potentiation of PRRSV-induced pneumonia.<sup>4</sup>

**In earlier research, Aureomycin decreased *M. hyo* potentiation of PRRSV disease.**

## ▶ EXPERIMENT DESIGN

- The study involved 112, 10- to 12-day-old crossbred barrows obtained from a herd seronegative for and not vaccinated for PRRSV or *M. hyo*.
- Pigs were randomly assigned to 7 treatment groups of 16 pigs each (stratification by weight), with each group housed in separate but identical rooms on raised decks (2 pens/deck, 4 pigs/pen) in isolation facilities at Iowa State University:
  - Mh = *M. hyo* challenge control;
  - Mh+Lincomix = *M. hyo* challenge + Lincomix (200 g/t for 21 days);
  - Mh+Aureomycin = *M. hyo* challenge + Aureomycin (10 mg/lb body weight, or 500 g/t, for 14 days);
  - MhPv = *M. hyo* and PRRSV challenge control;
  - MhPv+Lincomix = *M. hyo*/PRRSV challenge + Lincomix;
  - MhPv+Aureomycin = *M. hyo*/PRRSV challenge + Aureomycin;
  - Pv = PRRSV challenge.
- Aureomycin and Lincomix treatments were initiated 3 days prior to challenge.
- Respective treatment groups of pigs were inoculated intratracheally in the morning with *M. hyo* strain 232 (10 mL, 10<sup>5</sup> color changing units/mL) and/or intranasally in the afternoon with virulent PRRSV strain VR-2385 (1 × 10<sup>5</sup> TCID<sub>50</sub> in 2 mL) on trial day 0.
- Percent pneumonia, weight gain, clinical signs, and organism numbers were used to assess treatment efficacy.
- Pigs were weighed at -3, 10, 18, and 28 days post-infection (DPI) to evaluate weight gain. Pigs were scored daily for clinical respiratory signs (0=normal, 6=severe dyspnea and/or tachypnea when at rest) and coughing (0=no coughing, 1=coughing). Rectal temperatures were measured daily for 0 to 10 DPI and subsequently every other day until 28 DPI.
- Six pigs from each treatment group were necropsied at 10 DPI and the remaining pigs were necropsied at 28 DPI. Lungs were evaluated for macroscopic lesions of *M. hyo* and PRRSV pneumonia using previously described methods.<sup>5,6</sup> Tracheal swabs and lung samples were collected for *M. hyo* isolation. Bronchoalveolar lavage fluid (BAL) was obtained for quantification of *M. hyo* DNA and PRRSV RNA using real-time PCR assays.
- Blood was collected upon arrival, prior to challenge, and at each necropsy for determination of *M. hyo* and PRRSV antibody levels.
- Data were subjected to statistical analysis of variance (ANOVA).

**Aureomycin was compared to Lincomix in pigs infected with both *M. hyo* and PRRSV.**

## RESULTS

### PERFORMANCE

- PRRSV infection exerted the most impact on weight gains, as expected. At 18 and 28 DPI, all co-infected groups weighed significantly ( $P < 0.05$ ) less than groups infected only with *M. hyo.*
- Average daily gain was significantly improved by 40% from -3 to 10 DPI for co-infected pigs fed Aureomycin compared to animals treated with Lincomix (0.7 lb vs 0.5 lb, respectively).

**Aureomycin improved gains by 40% compared to Lincomix by 10 days post-infection.**

### FEVER AND COUGHING

- Co-infected groups experienced significantly ( $P < 0.05$ ) more febrile days from 1 to 10 DPI than groups infected only with *M. hyo.*
- Aureomycin significantly reduced the number of febrile days of co-infected pigs during the 11 to 28 DPI interval compared to either nonmedicated or Lincomix-medicated pigs.
- Co-infected pigs fed Aureomycin coughed significantly less than nonmedicated and Lincomix-treated pigs over the entire 28-day duration of the study (Figure 1, Table 1).
- This finding is important because, on the farm, coughing serves to transmit organisms from pig-to-pig and increase disease transmission within the herd.

**Coughing reduction is important because coughing transmits pathogens pig-to-pig.**

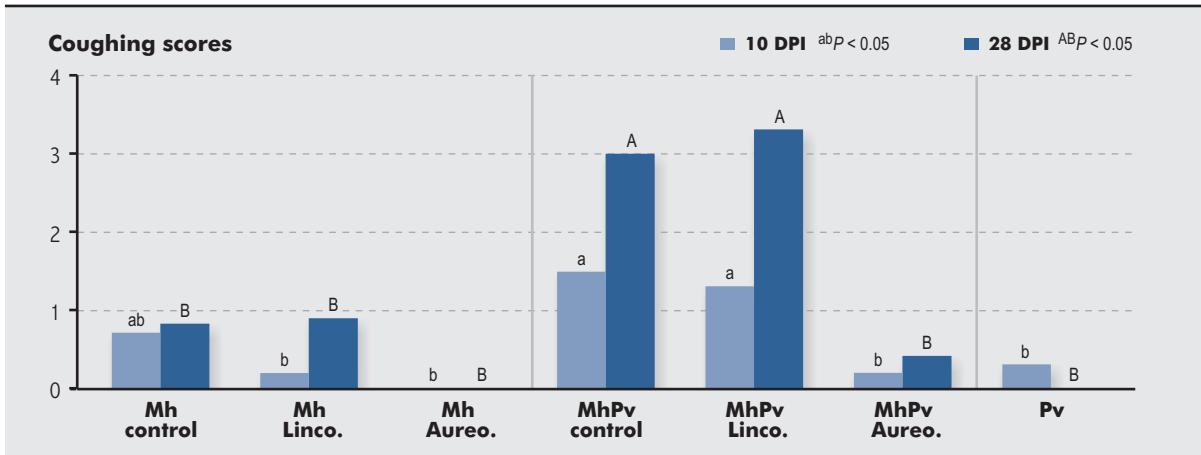


FIGURE 1: Coughing scores (0=no coughing, 1=coughing).

TABLE 1. Coughing scores (0=no coughing, 1=coughing).

Parameter	Mh cntrl.	Mh-Linco.	Mh-Aureo.	MhPv cntrl.	MhPv-Linco.	MhPv-Aureo.	Pv
Coughing scores, 1-10 DPI (%)	0.7 <sup>ab</sup>	0.2 <sup>b</sup>	0.0 <sup>b</sup>	1.5 <sup>a</sup>	1.3 <sup>a</sup>	0.2 <sup>b</sup>	0.3 <sup>b</sup>
Improvement vs control*	—	71%	100%	—	13%	87%	80%
Coughing scores, 11-28 DPI (%)	0.8 <sup>b</sup>	0.9 <sup>b</sup>	0.0 <sup>b</sup>	3.0 <sup>a</sup>	3.3 <sup>a</sup>	0.4 <sup>b</sup>	0.0 <sup>b</sup>
Improvement vs control*	—	-12.5%	100%	—	-10%	87%	100%

<sup>ab</sup> values with different superscripts within rows are significantly different ( $P < 0.05$ ) \*columns 3 & 4 vs column 2; columns 6-8 vs column 5

## RESULTS (CONT.)

### PNEUMONIA

- *M. hyo* is a slow-growing organism that normally takes weeks to cause pneumonia, but co-infection of *M. hyo* with PRRSV results in earlier and more severe *M. hyo* pneumonia lesions.
- PRRSV-induced pneumonia is generally maximal by 10 DPI, after which it begins to resolve. Co-infection with *M. hyo* increases the severity and duration of PRRSV-related pneumonia.
- Aureomycin administration to co-infected pigs resulted in a significant ( $P < 0.05$ ) reduction in *M. hyo* pneumonia at 10 and 28 DPI compared to nonmedicated and Lincomix-fed co-infected pigs (Figure 2, Table 2).
- By 28 DPI, the nonmedicated and Lincomix-treated co-infected pigs had significantly more severe *M. hyo*-related pneumonia than their *M. hyo*-only counterparts.
- Conversely, feeding Aureomycin negated the potentiating effect of PRRSV on mycoplasmal pneumonia as the amount of *M. hyo*-related pneumonia did not differ in the Aureomycin-fed groups, independent of challenge status.

**Aureomycin significantly reduced *M. hyo* pneumonia compared to Lincomix.**

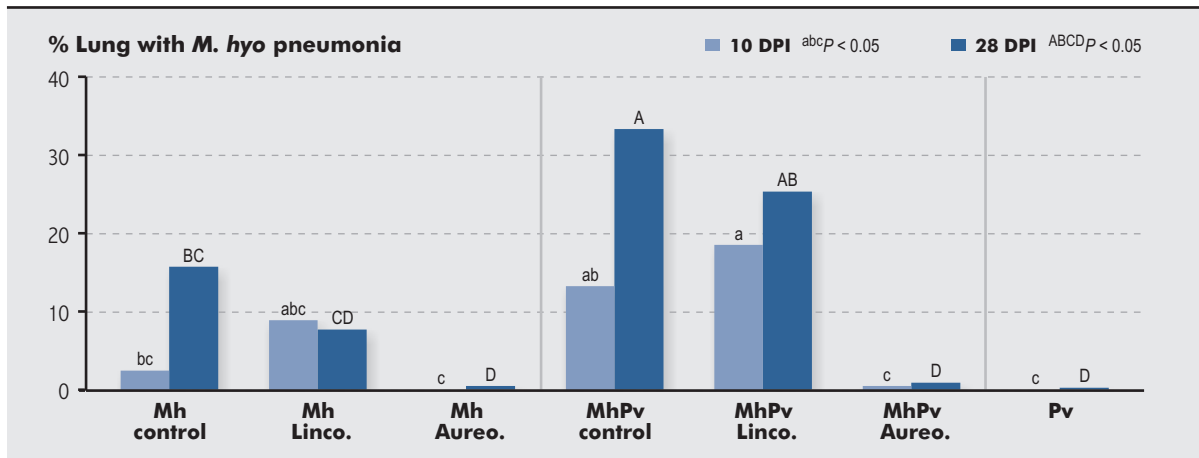


FIGURE 2: Percent of lung affected by macroscopic *M. hyopneumoniae* pneumonia.

**Aureomycin reduced *M. hyo* lung damage at both 10 and 28 days post-infection.**

TABLE 2. Percent of lung affected by macroscopic *M. hyopneumoniae* pneumonia.

Parameter	Mh cntrl.	Mh-Linco.	Mh-Aureo.	MhPv cntrl.	MhPv-Linco.	MhPv-Aureo.	Pv
Lung with <i>M. hyo</i> pneumonia, 10 DPI (%)	2.5 <sup>bc</sup>	8.8 <sup>abc</sup>	0.06 <sup>c</sup>	13.4 <sup>ab</sup>	18.5 <sup>a</sup>	0.4 <sup>c</sup>	0 <sup>c</sup>
Improvement vs control*	—	-25%	98%	—	-38%	97%	100%
Lung with <i>M. hyo</i> pneumonia, 28 DPI (%)	15.8 <sup>bc</sup>	7.6 <sup>cd</sup>	0.4 <sup>d</sup>	33.1 <sup>a</sup>	25.3 <sup>ab</sup>	0.7 <sup>d</sup>	0.2 <sup>d</sup>
Improvement vs control*	—	52%	97%	—	24%	98%	99%

<sup>abcd</sup> values with different superscripts within rows are significantly different ( $P < 0.05$ )

\*columns 3 & 4 vs column 2; columns 6-8 vs column 5

## ▶ RESULTS (CONT.)

- At both 10 DPI and 28 DPI, PRRSV-related pneumonia was significantly ( $P < 0.05$ ) less in co-infected pigs fed Aureomycin compared to nonmedicated and Lincomix-treated pigs (Figure 3, Table 3).
- These results demonstrate the ability of Aureomycin to mitigate the potentiating effect of *M. hyo* on PRRSV pneumonia.

**PRRSV pneumonia was significantly less in pigs fed Aureomycin instead of Lincomix.**

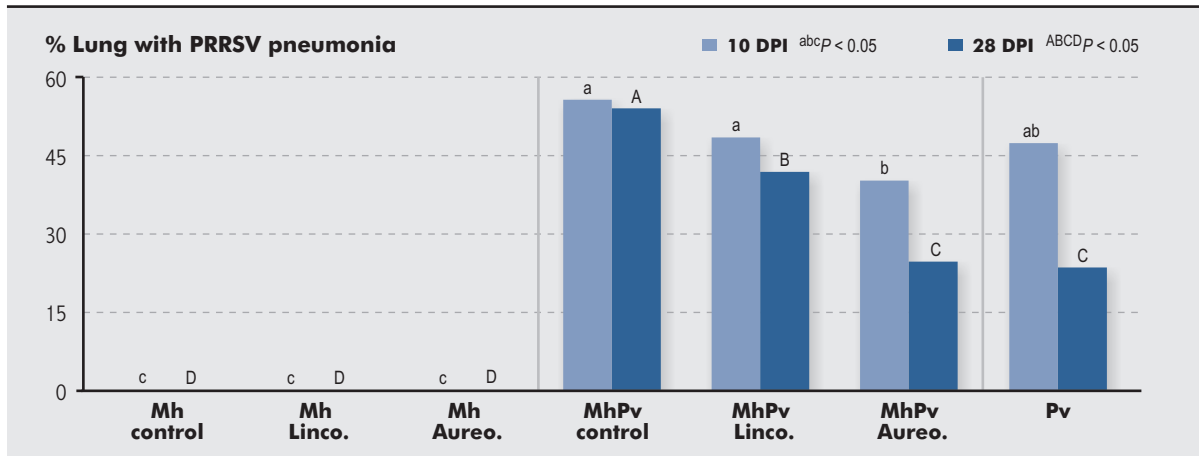


FIGURE 3: Percent of lung affected by macroscopic PRRSV pneumonia.

TABLE 3. Percent of lung affected by macroscopic PRRSV pneumonia.

Parameter	Mh cntrl.	Mh-Linco.	Mh-Aureo.	MhPv cntrl.	MhPv-Linco.	MhPv-Aureo.	Pv
Lung with PRRSV pneumonia, 10 DPI (%)	0 <sup>c</sup>	0 <sup>c</sup>	0 <sup>c</sup>	55.3 <sup>a</sup>	48.5 <sup>a</sup>	39.8 <sup>b</sup>	47.0 <sup>ab</sup>
Improvement vs control*	—	0%	0%	—	12%	28%	15%
Lung with PRRSV pneumonia, 28 DPI (%)	0 <sup>d</sup>	0 <sup>d</sup>	0 <sup>d</sup>	53.8 <sup>a</sup>	41.9 <sup>b</sup>	24.2 <sup>c</sup>	23.1 <sup>c</sup>
Improvement vs control*	—	0%	0%	—	22%	55%	57%

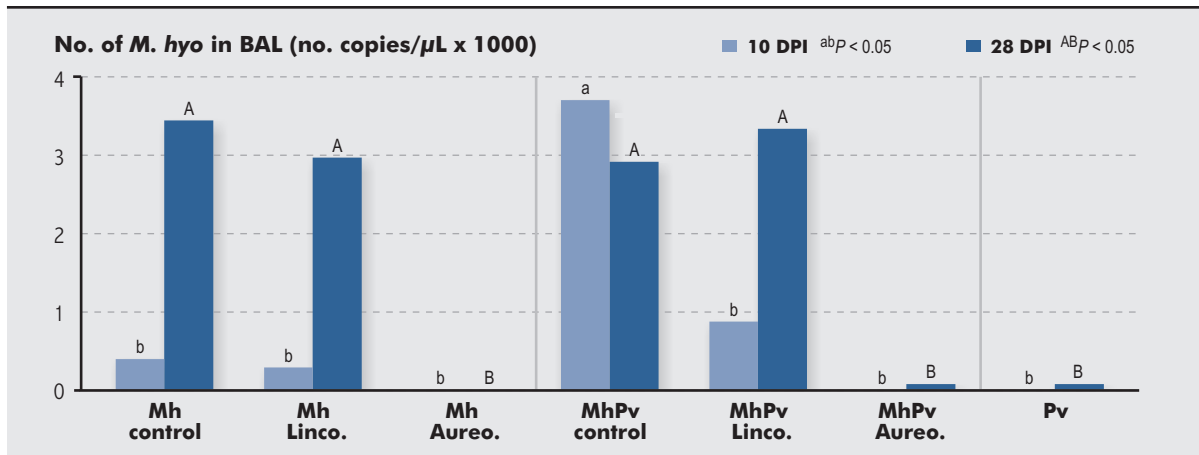
<sup>abcd</sup> values with different superscripts within rows are significantly different ( $P < 0.05$ ) \*columns 3 & 4 vs column 2; columns 6-8 vs column 5

## ORGANISMS IN LUNGS

- No significant differences were observed between treatment groups regarding the level of PRRSV RNA recovered from BAL at either necropsy.
- In contrast, both medicated groups of co-infected pigs at 10 DPI had significantly ( $P < 0.05$ ) lower levels of *M. hyo* DNA in BAL compared to the nonmedicated co-infected group (Figure 4, Table 4).

## RESULTS (CONT.)

- By 28 DPI, both groups of Aureomycin-medicated pigs had significantly lower levels of *M. hyo* DNA in BAL compared to groups medicated with Lincomix or nonmedicated controls.



By day 28, only pigs fed Aureomycin had lower levels of *M. hyo* in lung secretions.

FIGURE 4: *M. hyopneumoniae* organisms (no. copies/μL × 1000) in bronchoalveolar lavage fluid (BAL).

TABLE 4. *M. hyopneumoniae* organisms (no. copies/μL × 1000) in bronchoalveolar lavage fluid (BAL).

Parameter	Mh cntrl.	Mh-Linco.	Mh-Aureo.	MhPv cntrl.	MhPv-Linco.	MhPv-Aureo.	Pv
No. of <i>M. hyo</i> in BAL, 10 DPI	0.14 <sup>b</sup>	0.09 <sup>b</sup>	0 <sup>b</sup>	1.38 <sup>a</sup>	0.32 <sup>b</sup>	0 <sup>b</sup>	0 <sup>b</sup>
Improvement vs control*	—	36%	100%	—	77%	100%	100%
No. of <i>M. hyo</i> in BAL, 28 DPI (%)	1.29 <sup>a</sup>	1.11 <sup>a</sup>	0 <sup>b</sup>	1.08 <sup>a</sup>	1.25 <sup>a</sup>	0.01 <sup>b</sup>	0.01 <sup>b</sup>
Improvement vs control*	—	52%	97%	—	24%	98%	99%

<sup>ab</sup> values with different superscripts within rows are significantly different ( $P < 0.05$ ) \*columns 3 & 4 vs column 2; columns 6-8 vs column 5

The number of pigs culture-positive for *M. hyo* was reduced 89% to 100% by Aureomycin.

- The positive impact of Aureomycin on *M. hyo* numbers was further confirmed by the low rate of culture isolation from pigs (only 0-6%) compared to animals treated with Lincomix (56-73%) (Table 5).
- This low rate of infection correlated with the absence of sero-conversion observed in the Aureomycin-medicated pigs.

TABLE 5. Pigs culture-positive for *M. hyopneumoniae* at day 28.

Parameter*	Linco.	Aureo.	Aureo. improve.
<i>M. hyo</i> -only pigs, <i>M. hyo</i> -positive (%)	73	0	100%
Co-infected pigs, <i>M. hyo</i> -positive (%)	56	6	89%

\*data not statistically analyzed

## ▶ RESULTS (CONT.)

### STATISTICAL SUMMARY

- As summarized in Table 6, Aureomycin was more effective than Lincomix in controlling the clinical disease as described by:
  - weight gains;
  - coughing;
  - febrile days;
  - the severity and duration of *M. hyo*-potentiated PRRSV pneumonia;
  - the severity of pneumonia induced by *M. hyo* (especially in the presence of PRRSV);
  - quantity of *M. hyo* DNA in lung secretions (BAL), culture-positive pigs, and serology.

**Aureomycin was more effective than Lincomix in controlling disease.**

**TABLE 6. Summary of parameters significantly different ( $P < 0.05$ ) for Aureomycin vs Lincomix.**

Parameter	Linco.	Aureo.	Aureo. improve.
ADG, co-infected pigs, -3 to 10 DPI (lb)	0.5 <sup>a</sup>	0.7 <sup>b</sup>	29%
Coughing score, co-infected pigs, 1-10 DPI	1.3 <sup>a</sup>	0.2 <sup>b</sup>	85%
Coughing score, co-infected pigs, 11-28 DPI	3.3 <sup>a</sup>	0.4 <sup>b</sup>	88%
No. febrile days, 11-28 DPI	3.1 <sup>a</sup>	1.5 <sup>b</sup>	52%
<i>M. hyo</i> pneumonia, co-infected pigs, 10 DPI (%)	18.5 <sup>a</sup>	0.4 <sup>b</sup>	98%
PRRSV pneumonia, co-infected pigs, 10 DPI (%)	48.5 <sup>a</sup>	39.8 <sup>b</sup>	18%
<i>M. hyo</i> pneumonia, co-infected pigs, 28 DPI (%)	25.3 <sup>a</sup>	0.7 <sup>b</sup>	97%
PRRSV pneumonia, co-infected pigs, 28 DPI (%)	41.9 <sup>a</sup>	24.2 <sup>b</sup>	42%
<i>M. hyo</i> copies/ $\mu$ L, <i>M. hyo</i> -only pigs, 28 DPI	1112 <sup>a</sup>	0.4 <sup>b</sup>	99.9%
<i>M. hyo</i> copies/ $\mu$ L, co-infected pigs, 28 DPI	1251 <sup>a</sup>	10.4 <sup>b</sup>	99.2%

<sup>ab</sup> values with different superscripts within rows are significantly different ( $P < 0.05$ )

## ▶ CONCLUSIONS

This study provided further evidence that Aureomycin is a valuable tool for controlling mycoplasmal pneumonia, particularly in pigs also infected with PRRSV. Pigs fed Aureomycin demonstrated significant improvements in multiple performance and disease-associated parameters compared to animals medicated with Lincomix. Most notably, the severity and duration of PRRSV pneumonia potentiated by *M. hyo*, as well as *M. hyo* pneumonia in general, were significantly reduced by Aureomycin compared to Lincomix. The benefits of Aureomycin extended far beyond the conclusion of the 14-day medication period.

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## NOTE:

In this technical bulletin, there may be references beyond the scope of the approved labeling for the discussed product(s) as well as investigational uses. However, the information included in this technical bulletin may be freely shared with veterinarians and other professionals.