# The potential for sample testing at the pen level to inform prudent antimicrobial selection for bovine respiratory disease treatment: investigations using a feedlot simulation tool

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# Supplementary File S2: Supplementary figures and tables

**Figures S2.1 to S2.5** – Evaluation of model performance for each key antimicrobial class against emerging independent surveillance data.

**Table S2.1.** Verification that model outputs at the *pen* and *feedlot* levels across n = 5,000 Monte Carlo simulations are consistent with empirically-derived model inputs for the baseline scenario (i.e., test-only control setting).

## Supplementary figures and tables

**Figure S2.1.** Evaluation of model performance for 15-membered ring macrolides against emerging, independent surveillance data. Figure depicts the range of likely resistance prevalence outcomes at the pen (yellow) and feedlot (grey) levels derived from the repeated random sampling of model inputs across 5,000 Monte Carlo simulations (first reported in [27]); in blue is the reference data used to calibrate the model. Superimposed on the figure in black are the population-averaged resistance prevalence estimates (and 95% confidence intervals) for *Mannheimia haemolytica* isolates from calves sampled at rehandling in 2022 (median DOF = 14), 2023 (median DOF = 70), and 2024 (median DOF = 45) as part of CFAASP [12, 47, 54]; these data were *not* used to calibrate the model in [27].

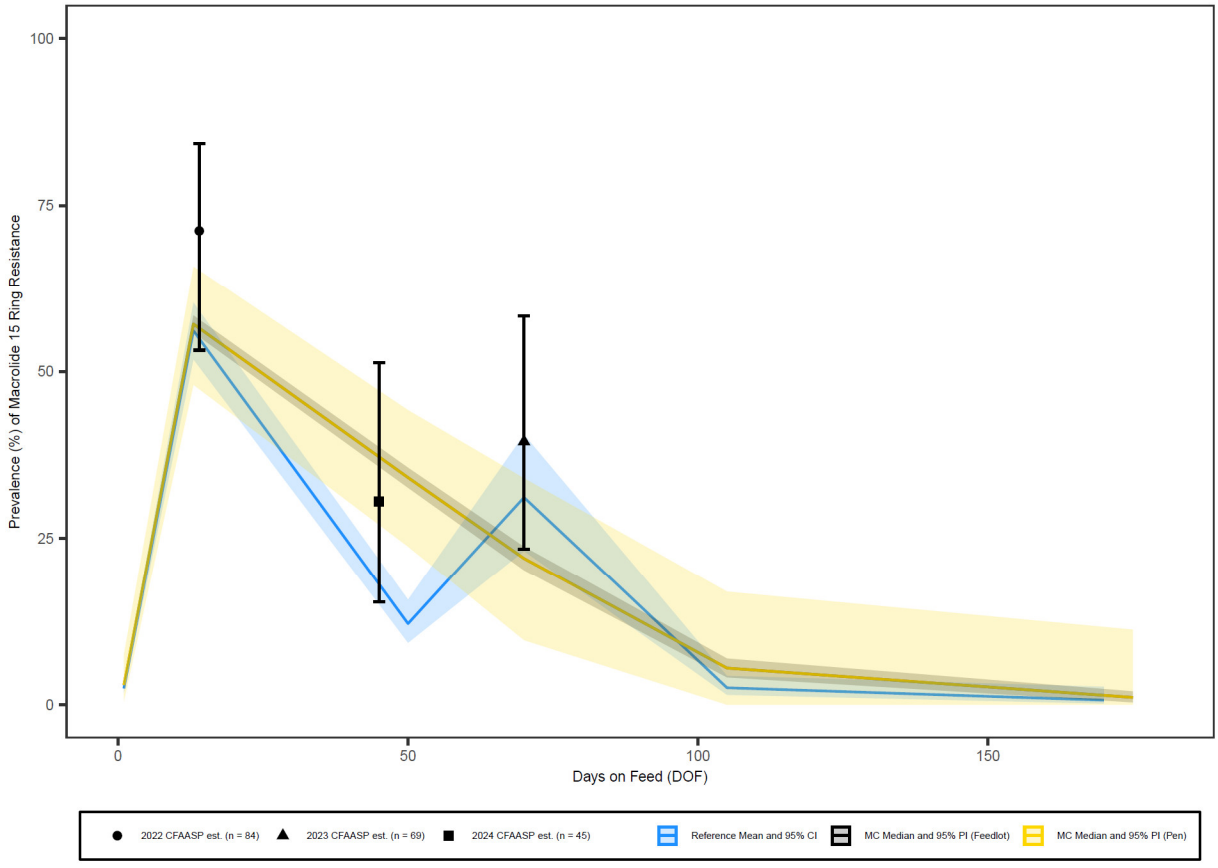

**Figure S2.2.** Evaluation of model performance for 16-membered ring macrolides against emerging, independent surveillance data. Figure depicts the range of likely resistance prevalence outcomes at the pen (yellow) and feedlot (grey) levels derived from the repeated random sampling of model inputs across 5,000 Monte Carlo simulations (first reported in [27]); in blue is the reference data used to calibrate the model. Superimposed on the figure in black are the population-averaged resistance prevalence estimates (and 95% confidence intervals) for *Mannheimia haemolytica* isolates from calves sampled at rehandling in 2022 (median DOF = 14), 2023 (median DOF = 70), and 2024 (median DOF = 45) as part of CFAASP [12, 47, 54]; these data were *not* used to calibrate the model in [27].

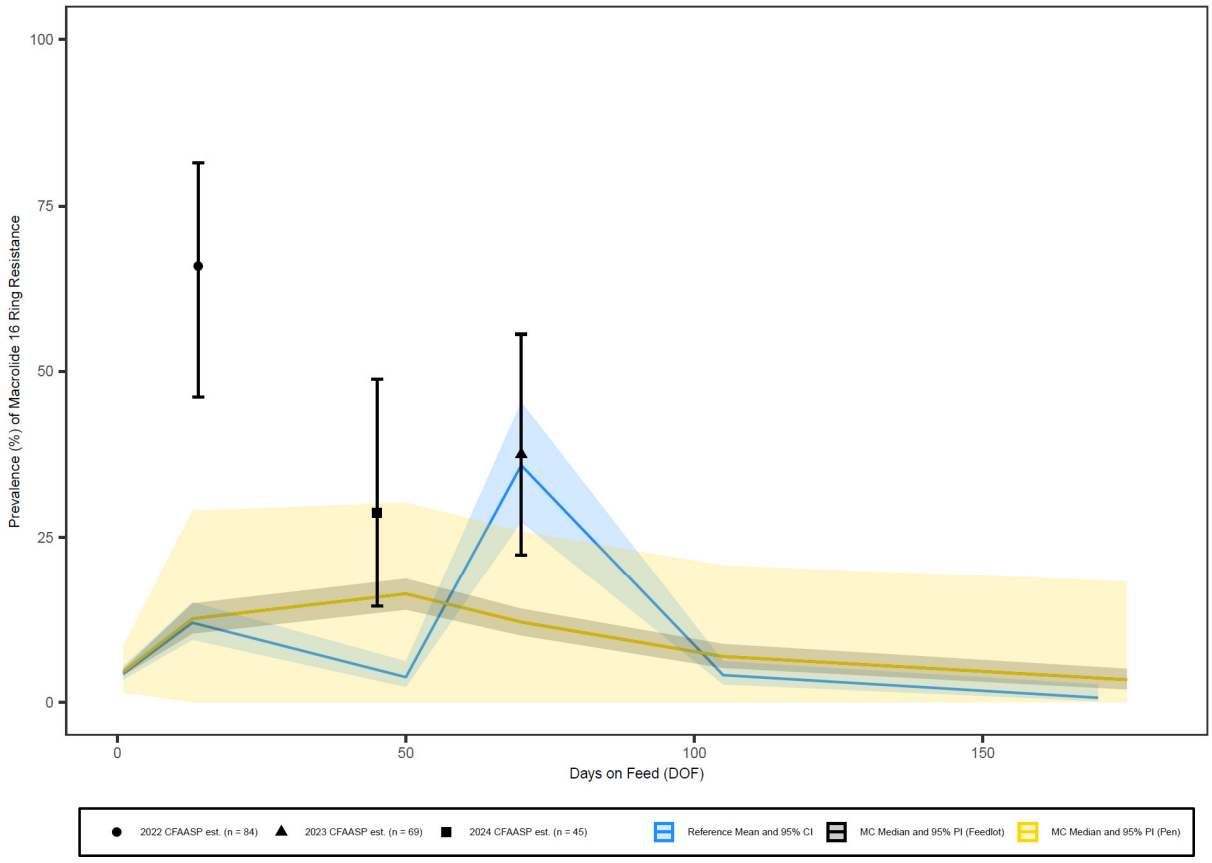

**Figure S2.3.** Evaluation of model performance for sulfonamides against emerging, independent surveillance data. Figure depicts the range of likely resistance prevalence outcomes at the pen (yellow) and feedlot (grey) levels derived from the repeated random sampling of model inputs across 5,000 Monte Carlo simulations (first reported in [27]); in blue is the reference data used to calibrate the model. Superimposed on the figure in black are the population-averaged resistance prevalence estimates (and 95% confidence intervals) for *Mannheimia haemolytica* isolates from calves sampled at rehandling in 2022 (median DOF = 14), 2023 (median DOF = 70), and 2024 (median DOF = 45) as part of CFAASP [12, 47, 54]; these data were *not* used to calibrate the model in [27].

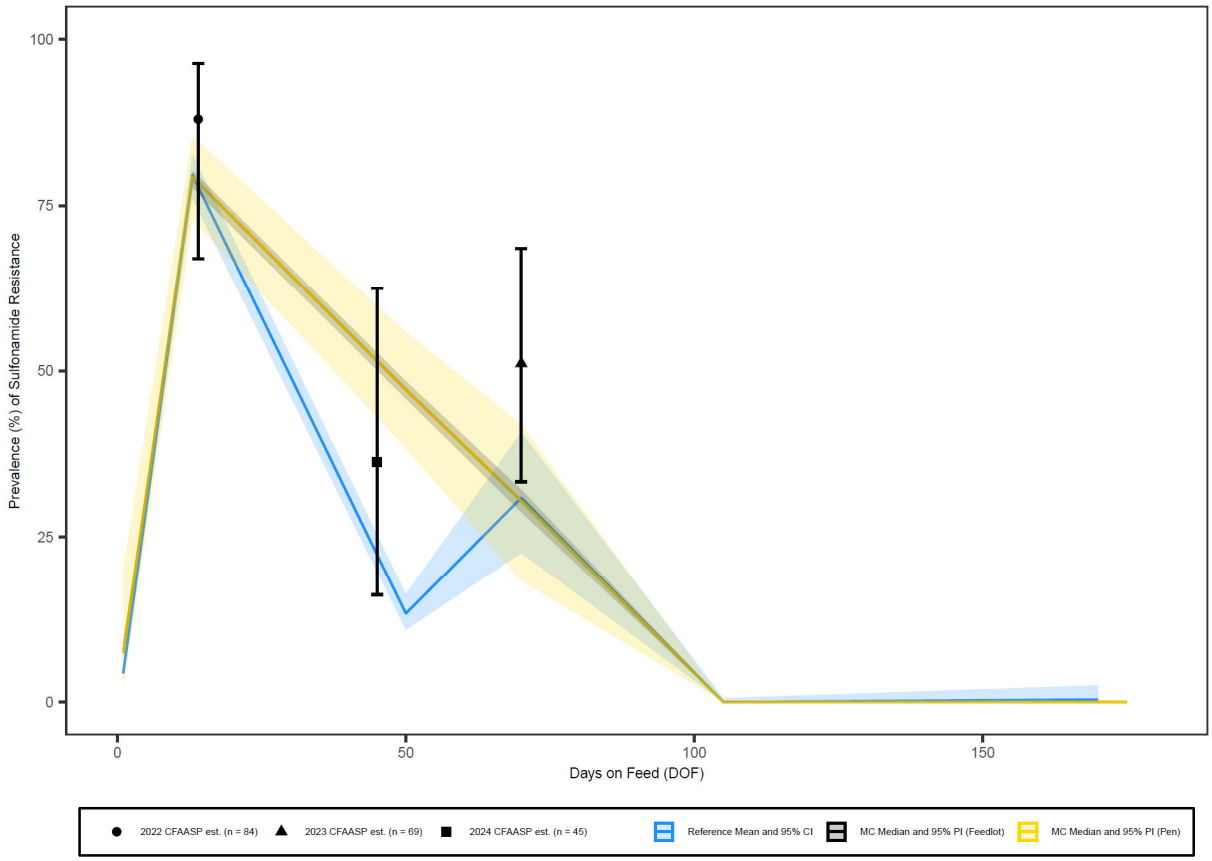

**Figure S2.4.** Evaluation of model performance for trimethoprim against emerging, independent surveillance data. Figure depicts the range of likely resistance prevalence outcomes at the pen (yellow) and feedlot (grey) levels derived from the repeated random sampling of model inputs across 5,000 Monte Carlo simulations (first reported in [27]); in blue is the reference data used to calibrate the model. Superimposed on the figure in black are the population-averaged resistance prevalence estimates (and 95% confidence intervals) for *Mannheimia haemolytica* isolates from calves sampled at rehandling in 2022 (median DOF = 14), 2023 (median DOF = 70), and 2024 (median DOF = 45) as part of CFAASP [12, 47, 54]; these data were *not* used to calibrate the model in [27].

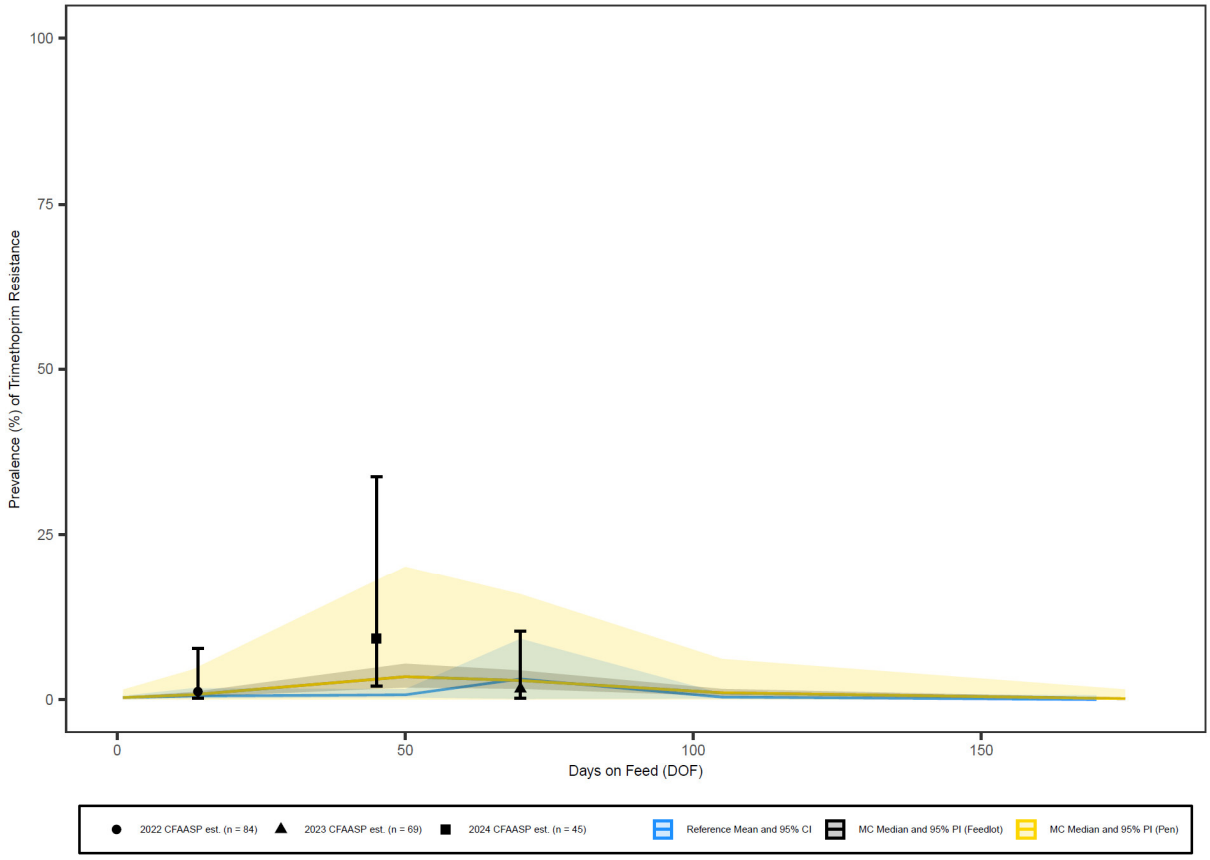

**Figure S2.5.** Evaluation of model performance for tetracyclines against emerging, independent surveillance data. Figure depicts the range of likely resistance prevalence outcomes at the pen (yellow) and feedlot (grey) levels derived from the repeated random sampling of model inputs across 5,000 Monte Carlo simulations (first reported in [27]); in blue is the reference data used to calibrate the model. Superimposed on the figure in black are the population-averaged resistance prevalence estimates (and 95% confidence intervals) for *Mannheimia haemolytica* isolates from calves sampled at rehandling in 2022 (median DOF = 14), 2023 (median DOF = 70), and 2024 (median DOF = 45) as part of CFAASP [12, 47, 54]; these data were *not* used to calibrate the model in [27].

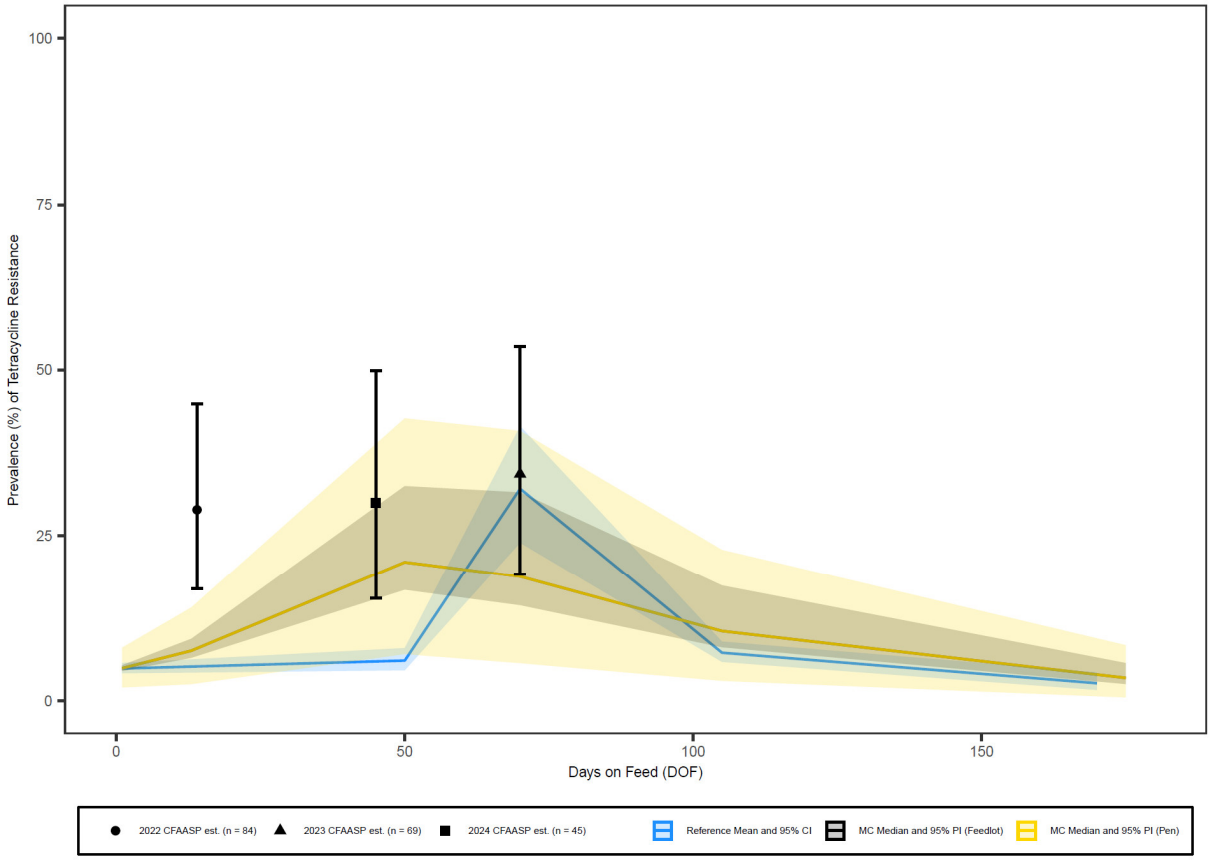

**Table S2.1.** Verification that model outputs at the *pen* and *feedlot* levels across n = 5,000 Monte Carlo simulations are consistent with empirically-derived model inputs for the baseline scenario (i.e., test-only control setting).

| | **Expected value, based on input (if applicable)** | **Observed value** | |
|---|---|---|---|
| | | **Pen level (median [95% PI])** | **Feedlot level (median [95% PI])** |
| ***Arrival outputs*** | | | |
| Number of calves placed | 9600 | 200 (200, 200) | 9600 (9600, 9600) |
| Average arrival weight (pounds) | 500 - 600 | 550 (546, 554) | 549 (549, 550) |
| ***Disease outputs*** | | | |
| Number of first BRD cases | 9.4% of all calves | -- | 931 (873, 988) |
| Number of second BRD cases (first relapses) | 21.6% of first cases | -- | 200 (174, 227) |
| Number of third BRD cases (second relapses) | 35.8% of second cases | -- | 71 (55, 89) |
| Number of first arthritis cases | 1.0% of all calves | -- | 94 (75, 113) |
| Number of second arthritis cases (first relapses) | 11.6% of first cases | -- | 10 (4, 18) |
| Number of third arthritis cases (second relapses) | 20.5% of second cases | -- | 2 (0, 5) |
| Number of fourth arthritis cases (third relapses) | 19.6% of third cases | -- | 0 (0, 2) |
| Number of foot rot cases | 3.0% of all calves | -- | 263 (229, 298) |
| ***Specialty pen outputs*** | | | |
| Number of calves with arthritis in hospital pen | All cases <1000 pounds & 50% of cases >1000 pounds | 2 (0, 5) | 90 (72, 109) |
| Calf-days in hospital pen | -- | 26 (0, 74) | 1266 (995, 1556) |
| Number of calves with BRD in chronic pen | 35.8% of third cases | 0 (0, 2) | 25 (16, 36) |
| Number of calves with arthritis in chronic pen | 50% of cases >1000 pounds | 0 (0, 1) | 4 (1, 9) |
| Calf-days in chronic pen | -- | 0 (0, 254) | 1982 (1077, 3133) |
| ***Mortality outputs*** | | | |
| Number of BRD deaths | 8.8% of first BRD cases | 1 (0, 4) | 73 (57, 91) |
| Average weight at BRD death (pounds) | -- | 718 (0, 1197) | 804 (757, 856) |
| Number of histophilosis deaths | 0.4% of all calves | 1 (0, 3) | 35 (24, 46) |
| Average weight at histophilosis death (pounds) | -- | 610 (0, 1066) | 769 (724, 829) |
| Number of other-cause deaths | 1.3% of all calves | 2 (0, 6) | 121 (97, 145) |
| Average weight at other-cause death (pounds) | -- | 905 (0, 1333) | 932 (871, 995) |
| ***Economics/finishing outputs*** | | | |
| Number of healthy calves finished to target weight | -- | 195 (190, 199) | 9343 (9309, 9376) |
| Average finishing weight of healthy calves (pounds) | 1325 - 1500 | 1417 (1332, 1498) | 1416 (1332, 1498) |
| Average daily gain (pounds per day) for healthy calves | 3.46 | 3.48 (3.41, 3.56) | 3.48 (3.47, 3.50) |
| Average days on feed for healthy calves | -- | 248 (224, 274) | 249 (224, 272) |
| Number of chronic calves finished to target weight | 33% of chronic calves | 0 (0, 1) | 9 (4, 16) |
| Number of chronic calves finished to reduced weight | 33% of chronic calves | 0 (0, 1) | 9 (4, 16) |
| Number of chronic calves euthanized | 33% of chronic calves | 0 (0, 1) | 10 (4, 16) |
| Average finishing weight of chronic calves | -- | 0 (0, 1222) | 1086 (1015, 1159) |
| Average daily gain (pounds per day) for chronic calves | -- | 0 (0, 3.97) | 3.34 (3.10, 3.57) |
| Average days on feed for chronic calves | -- | 0 (0, 237) | 163 (139, 190) |