NebGuide

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Antimicrobials Used for Metaphylaxis and Implications for Product Diversification in the Animal Health Sector

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This NebGuide summarizes the results of national studies done in 2011 and 2016 of antimicrobials used for metaphylaxis by US cattle feedlots.

In May 2019, the National Animal Health Monitoring System (NAHMS) released the Antimicrobial Use and Stewardship baseline report for cattle feedlots and swine operations in the United States. The report was based on a national study focusing on how antimicrobials were used in US cattle feedlots and swine operations during 2016. This report, planned to be conducted biannually moving forward, aimed to capture antimicrobial use prior to the federally mandated Veterinary Feed Directive (VFD), which became effective on January 1, 2017. The VFD required all livestock producers to obtain a "prescription" from a licensed practicing veterinarian before administering antimicrobials. Follow-up studies from NAHMS will observe how the VFD changed producer antimicrobial use behavior.

In 2011, NAHMS conducted a similar study that recorded antimicrobial use for US cattle feedlots with over 1,000 head capacity. This publication aims to provide context on how antimicrobial use for US cattle feedlots with 1,000+ head capacity has changed between 2011 and 2016. All data utilized here comes from three sources: (1) Food and Drug Administration (FDA) reports on antimicrobial sales, (2) NAHMS Feedlot 2011 Part IV: Health and Health Management on US Feedlots with a Capacity of 1,000 or More Head, and (3) NAHMS Feedlot 2017: Antimicrobial Use and Stewardship. The assessment focuses solely on the use of injectable antimicrobials in US cattle feedlots with 1,000+ head one-time capacity. Specifically, this publication examines how these producers have changed their use of metaphylaxis, administration of an FDA approved injectable antimicrobial to more than 90% of cattle in a group to prevent or control an outbreak of bovine respiratory disease. The focus is on metaphylaxis since there is considerable domestic and international conversation about whether this animal health practice should be further regulated.

Historical Injectable Antimicrobial Sales by Volume

To place metaphylaxis use in context, it is useful to examine historical trends in injectable antimicrobial sales over time (Sales within a given year are likely to overstate actual use of injectable antimicrobials within a given year. Observing sales over time somewhat alleviates this concern.). Since 2009, the FDA has reported injectable antimicrobial sales across all food-producing species. Species-specific injectable antimicrobial sales are not available. Injectable antimicrobial use steadily decreased from the high in 2010–2011. It has maintained near its current level since 2013 (see *Figure 1*). Note that injectable antimicrobial sales consist of both antimicrobials used for treatment of sick animals and metaphylaxis.

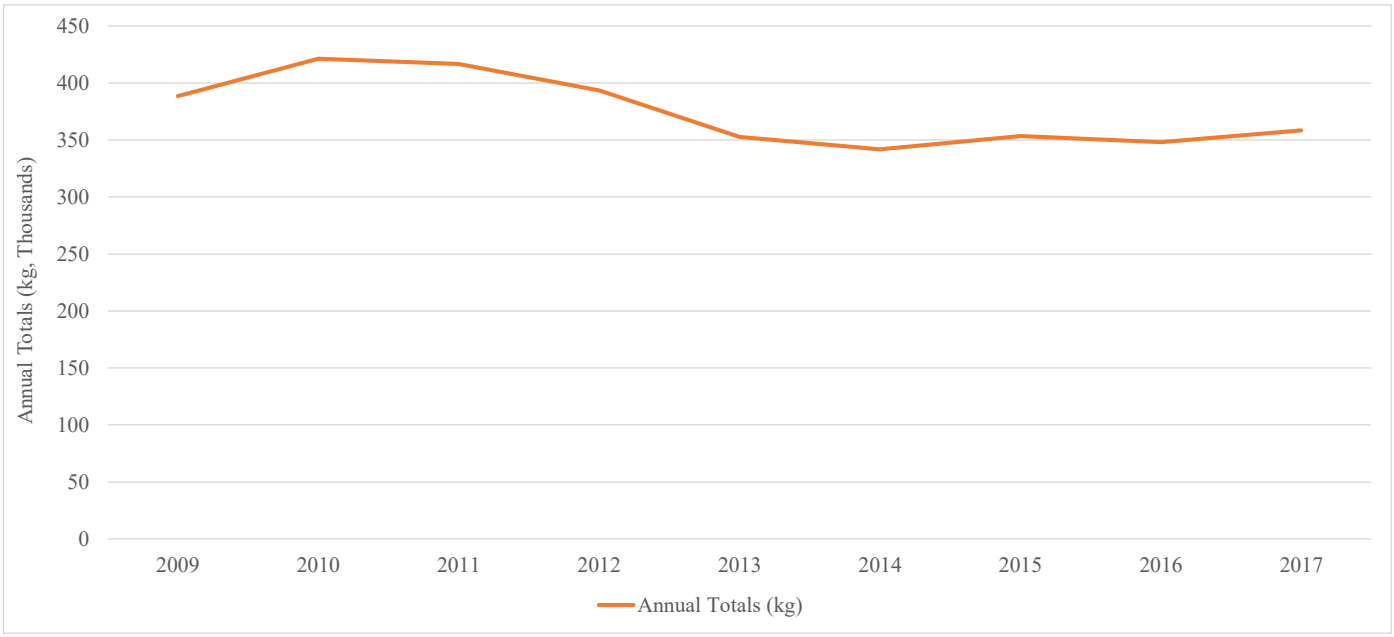

Figure 1. US injectable antimicrobial sales across all food-producing animals, 2009–2017

US Cattle Feedlot Metaphylactic Use

National averages of metaphylaxis use in 2011 and 2016 are obtained from their respective NAHMS report. NAHMS surveyed 125 and 228 cattle feedlots with 1,000+ one-time head capacity across the US in 2011 and 2016, respectively. Examining the number of feedlots using metaphylaxis reveals the prevalence of metaphylaxis as an animal health practice.

Between 2011 and 2016 the number of feedlots using metaphylaxis statistically decreased from 59.3 (4.2)% to 39.3 (3.4)%. Numbers in parentheses are standard errors reported by NAHMS. Likewise, the number of cattle managed using metaphylaxis statistically decreased from 21.3 (2.3)% to 17.0 (1.6)%.

Antimicrobials used for Metaphylaxis in US Feedlots

While cattle feedlots have decreased their use of metaphylaxis, the type of antimicrobials used reveals information about producer preferences. Table 1 displays how the use of different antimicrobials for metaphylaxis have changed between 2011 and 2016. US cattle feedlots have moved away from Tilmicosin and Ceftiofur in favor of different or newer antimicrobials. For example, between 2011 and 2016 the share of feedlots using Tilmicosin (Ceftiofur) was reduced from 32.91% to 15.58% (22.69% to 13.55%), respectively. In other words, fewer feedlots are using Tilmicosin and Ceftiofur for metaphylaxis. The share of feedlots using Tulathromycin increased from 25.89% to 28.66%. Tildipirosin and Gamithromycin demonstrated the largest growth in feedlot share of use.

The share of cattle managed by different types of antimicrobials details a more accurate picture of specific antimicrobial demand by US cattle feedlots and reveals a similar story (see *Table 1*). The share of cattle managed with Tilmicosin and Ceftiofur decreased, Tulathromycin increased, and Tildipirosin and Gamithromycin had the largest increase in market share. These movements in market shares are substantial. For example, 46% of cattle were managed with Tilmicosin in 2011. This decreased to 10% in 2016. On the other hand, no cattle (0%) were managed with Gamithromycin in 2011 compared to 18% of cattle in 2016.

Antimicrobial Product Diversification

There appears to be some descriptive evidence that the market for injectable antimicrobials labeled for metaphylaxis use has become more "diversified". For example, in 2011 Ceftiofur, Oxytetracycline, Tilmicosin, and Tulathromycin were used by 91% of feedlots on 93% of cattle. This decreased to 68% and 55% in 2016. However, with large increases in the Tildipirosin and Gamithromycin market diversification could have remained unchanged.

The Herfindahl-Hirschman Index (HHI) is one way of examining market diversification. The HHI is commonly

Table I. Comparison of antimicrobials used for metaphylaxis between 2011 and 2016

Antimicrobial	Feedlots				Cattle			
	Percent[a]		Share[b]		Percent		Share	
	2011	2016	2011	2016	2011	2016	2011	2016
Amoxicillin	0	0.5	0.00	0.78	0	0	0.00	0.00
Ceftiofur	39.7	8.7	22.69	13.55	13.8	1.1	13.81	6.51
Danofloxacin	—[c]	0.8	—	1.25	—	0	—	0.00
Enrofloxacin	—	1.1	—	1.71	—	0.2	—	1.18
Florfenicol	9.2	3.8	5.26	5.92	6.4	0.9	6.41	5.33
Florfenicol with flunixin meglumine	—	1.4	—	2.18	—	0.6	—	3.55
Gamithromycin	4.3	5.1	2.46	7.94	0.1	3.2	0.10	18.93
Oxytetracycline	17.4	7	9.94	10.90	4	1.5	4.00	8.88
Penicillin	0	1.2	0.00	1.87	0	0.1	0.00	0.59
Tildipirosin	—	5.8	—	9.03	—	2.5	—	14.79
Tilmicosin	57.6	10	32.91	15.58	46	1.7	46.05	10.06
Tulathromycin	45.3	18.4	25.89	28.66	29.5	5.1	29.53	30.18
Other	1.5	0.4	0.86	0.62	0.1	0	0.10	0.00

Note: [a] Numbers do not sum to 100 because individual feedlots can choose to use more than one type of antimicrobial for metaphylaxis. [b] Shares are derived by dividing the percent of each drug by the sum total across the percent column. [c] Producers were not asked if they used this type of antimicrobial.

Source: NAHMS (2013, 2019) and author's calculations

used to measure market competitiveness but has been used to examine concentration, export share dependence, and product diversification. For example, the US Department of Justice considers markets with an HHI between 1,500 and 2,500 to be "moderately concentrated," and in excess of 2,500 to be "highly concentrated." The HHI was calculated using the share of each antimicrobial.

Changes in producer preferences have increased market diversification of injectable antimicrobials labeled for metaphylaxis use. The HHI based on feedlot antimicrobial share decreased from 2,401 to 1,560. Likewise, the HHI based on cattle antimicrobial share decreased from 3,240 to 1,753.

These findings should be considered with great caution as injectable antimicrobials are differentiated products and may not be perfect substitutes. For example, Tulathromycin and Oxytetracycline are known to be used on different types of cattle due the cost-efficacy trade-off. US cattle feedlots aim to minimize cost of morbidity and mortality by matching antimicrobial efficacy to perceived or realized cattle health. Thus, a more representative HHI may consider the "quality/class/tiers" of antimicrobials by their ability to reduce cattle morbidity and mortality.

Summary

The purpose of this NebGuide is to summarize and compare how the use of metaphylaxis in US cattle feedlots has changed between 2011 and 2016; to further appreciate how producers have changed the frequency of metaphylaxis between these two time periods and how these adjustments impacted product diversification of antimicrobials. A key point illustrated is that the type and share of antimicrobial used by feedlots and received by cattle have changed. This has *potentially* resulted in a more diversified injectable antimicrobial, labeled for metaphylaxis use, market. These conclusions and findings should be held in the context of the limitations stated within this publication.

This publication has been peer reviewed.
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