



ANTIBIOTIC STEWARDSHIP REPORT



JUNE 2023

Welcome to our third annual Antibiotic Stewardship Report. Hormel Foods, named one of America's Most Responsible Companies by Newsweek and one of the 100 Best Corporate Citizens by 3BL Media, has published its annual global impact report for 16 years. Through *Our Food Journey*[™], we are committed to transparency and truly making a difference in the world. We know that building social value and creating economic value are not competing goals, and we are proud to share with our stakeholders this special supplemental report that provides more information on our antibiotic stewardship efforts as well as presents metrics for portions of our supply chain.

Our antibiotic stewardship and leadership are well documented on our company's website and in various publications. Not only have we invested in raising animals without antibiotics, we have also been advocates of alternative approaches to animal health and well-being to minimize the need for antibiotics.

We commit to furthering our partnership work with leading experts in animal and human health, by using science and technology to continue to make a difference in this important area.



INTRODUCTION



By Dr. Michelle Kromm

Michelle Kromm is a boarded member of the American College of Poultry Veterinarians and earned a Doctor of Veterinary Medicine degree from Iowa State University, a Master of Public Health degree from the University of Iowa and a Master of Avian Medicine degree from the University of Georgia. Dr. Kromm has served as an internal adviser as staff veterinarian with Jennie-O Turkey Store in 2007 and worked in various leadership roles until 2022 when she became an external adviser for Hormel Foods.

Antibiotic resistance is a complex, multifaceted issue. A positive impact on antibiotic resistance will come only through taking a holistic approach to antimicrobial stewardship, aided by key partnerships to create an impact beyond individual supply chains. It's through a balanced approach to stewardship that collectively we can make an impact on antibiotic resistance.

When components of an antibiotic stewardship program function effectively, the health of the animals is optimized while the occurrence and impact of disease are minimized. The antibiotic stewardship program at Hormel Foods, which includes its subsidiaries, is based on four principles: management, preventive medicine, veterinary oversight and continuous improvement. Let's take a closer look at each of these important components.

MANAGEMENT

Production and housing systems that address the basic needs of the animals and are designed to minimize the risk of disease introduction are the foundation on which the other principles are built. Providing an appropriate environment, including proper housing and temperature, as well as ample access to feed and water, increases the animal's resiliency to infection and disease by supporting the development of a healthy immune system. Systematic segregation of groups of animals based on health status is an additional tool utilized to address the welfare needs of at-risk populations while simultaneously protecting the broader animal population from increased disease risk.

PREVENTIVE MEDICINE

The next layer of the antibiotic stewardship program at Hormel Foods is comprised of preventive medicine programs. Specialized company and contract veterinarians are employed to develop programs and procedures focused on disease prevention. A farm's preventive medicine program outlines potential routes of disease introduction and how to mitigate those risks (often referred to as biosecurity), as well as strategies to support the overall health and welfare of the animals. Components of this principle include sanitation protocols, appropriate barn entry procedures and vaccine programs to protect animals from common pathogens.

VETERINARY OVERSIGHT

Veterinary oversight is critical to ensure judicious antibiotic use. Veterinarians have a deep understanding of disease processes, the development of antimicrobial resistance (AMR) and animal welfare. Consequently, they have the expertise to navigate the interrelatedness between antibiotic use, animal welfare and public health when making treatment decisions.

CONTINUOUS IMPROVEMENT

A commitment to continuous improvement is the final principle of the antibiotic stewardship program at Hormel Foods. Previously, the company has established a guideline to strive reduce our antimicrobial use by 10% year over year. However, a myopic approach solely focused on the measurement of antibiotic use has the potential to create unacceptable tradeoffs between animal health and welfare, as does the expectation for consistent reduction in antibiotic use over time. If an animal is sick, it should be treated, when deemed by a veterinarian to be necessary. While farm partners of Hormel Foods do their best to prevent health issues on the farms, in some cases illness is unavoidable and must be addressed. To provide a more complete view, this report also offers insights on the company's investments in antibiotic alternatives such as probiotics, prebiotics and essential oils.

(Please see the [white paper](#) published in December 2021 for more information.) Continual refinement of management and preventive medicine programs, engagement with veterinary experts and a commitment to continual improvement are all critical principles of a comprehensive antibiotic stewardship program.



OUR
FOCUS
AREAS

At Hormel Foods, we understand the importance of using antibiotics responsibly in all settings, including animal agriculture. Protecting human health and the health of our animals is of the utmost importance, and we are proud of our ongoing stewardship efforts. We focus our efforts in the following ways:

The four core principles of our stewardship program – Improving health outcomes for the animals in our supply chain is the most effective and sustainable way to improve antibiotic-use practices. The four core principles of our stewardship program are:

- Managing systems and housing to provide the appropriate environments;
- Utilizing preventive medicine programs developed by veterinarians to support the health of the animals;
- Ensuring antibiotic treatment is utilized only when necessary and appropriate through veterinary oversight; and
- Continually evaluating, investing in and improving our antibiotic stewardship program.

Partnering with stakeholders – Antimicrobial resistance is a complex issue that requires collaboration by all stakeholders. It is only through partnerships that we have a chance to make a significant impact on the emergence of antibiotic resistance. In 2015, we formed an antibiotic working group comprised of internal subject-matter experts, leading nongovernmental organizations, independent veterinarians and other stakeholders to discuss and continue to advance this important industry topic. We also review and explore research opportunities and participate in industry antibiotic initiatives. Additionally, we are working to support broader dialog around the challenges of addressing AMR through membership in the National Institute of Antimicrobial Resistance Research and Education.

Producing raised-without-antibiotics products – Hormel Foods has invested in producing raised-without-antibiotics products. Our *Applegate*[®] product portfolio is produced entirely from animals raised without antibiotics. If antibiotics are given to an animal, that animal does not enter the Applegate supply chain. In addition, we offer several raised-without-antibiotics foodservice items, *Columbus*[®] products and *Jennie-O*[®] products.



A HOLISTIC
APPROACH

We are committed to taking a holistic approach to animal care – one that puts the health and comfort of the animals first. Our team is dedicated to the development of sound management and preventive medicine programs to keep animals healthy and minimize the need for antibiotic treatment. These programs include providing appropriate shelter to keep the animals comfortable, feeding rations formulated by professional nutritionists and ample access to clean, fresh water. In addition, we utilize veterinary expertise to: 1) establish procedures to mitigate the risk of disease introduction into animal populations, 2) develop vaccine programs to minimize the occurrence and impact of disease, and 3) treat animals with an appropriate antibiotic if it becomes medically necessary to do so.

MANAGEMENT

There are several systems changes our partners have made to improve the health outcomes of hogs and turkeys within our supply chain. For example, within our hog supply chain these changes include increasing the age at which pigs are weaned, leading to more robust piglets, batch farrowing at some sow farms and minimizing sourcing of pigs for market hog sites. Both of these latter strategies minimize the mixing of pigs of differing health statuses, which reduces the risk of disease and therefore, the need for antibiotic treatment.

Over the last few years, Jennie-O has been partnering with a technology company to develop a modified hatching system that changes how turkeys are managed during their first few days of life. This advanced system elevates the level of care newly hatched poults receive. Among other outcomes, this supports early development of their immune systems.

Both our hog supply partners and our Jennie-O subsidiary segregate offspring of breeding stock when they first come into production. Often, the piglets and turkey poults require extra attention and care from the start of a reproductive cycle. Through segregation, producers can improve the health outcomes for these specific groups of at-risk animals. Although these system changes take months to years to institute, they are critical to improving health outcomes for the hogs and turkeys in our supply chain.

Utilizing the available technology to ensure environmental conditions are comfortable and consistent is another focus area for our turkey and hog suppliers. The use of computerized barn-monitoring systems allows for the constant measurement and adjustment of environmental conditions such as temperature, humidity and ventilation rates to ensure animals are comfortable. Many monitoring systems also capture feed and water consumption patterns. This information is particularly useful, as reduced feed and water consumption are often the first indicators that animals aren't feeling well. This behavior can trigger early intervention through supportive care (such as providing a little more heat or providing vitamins or probiotics in the water), potentially avoiding antibiotic treatment altogether.

PREVENTIVE MEDICINE

There are two main aspects of disease prevention that need to be addressed in a comprehensive program. First, procedures and policies need to be in place to mitigate the various ways in which diseases are introduced to a farm or barn, collectively known as a biosecurity program. Biosecurity programs cover a wide variety of mitigation strategies. Examples of biosecurity efforts at the farms represented in this report include: all individuals entering a barn of breeding stock are required to shower in/shower out; site-specific clothing, footwear and gloves are worn at all commercial hog and turkey farms; and thorough sanitation practices are in place for all transportation vehicles.

The second aspect of preventive medicine is direct support of animal health. The cornerstone of this aspect is a vaccine program that targets common pathogens – the viruses and/or bacteria that cause disease – to which hogs or turkeys could be exposed. A recent example of this is the integration of a vaccine for *streptococcus suis* being implemented into the overall preventive medicine program at our company-owned sow farm. Additionally, partners within our hog supply chain are focused on water quality to help support young pigs and turkeys, as they are often challenged by gastrointestinal upset early in life. To ensure clean, quality water, farmers may filter or treat water before it enters the drinking water system for the animals. Animal feed composed of quality ingredients and containing the proper nutrients is critical to support health and development. It is a common practice to screen feed ingredients to assess nutrient quality as well as to look for contaminants, such as toxins produced by moldy ingredients.

VETERINARY OVERSIGHT

We employ a team of veterinarians at our Jennie-O subsidiary and have partnered with a leading veterinary clinic to help define long-term health strategies for our company-owned sow farm. Each farm in our supplier network is also required to have veterinary care. This network of veterinarians is committed to understanding ways to minimize antibiotics by innovating in areas of animal husbandry and preventive medicine. In addition, veterinarians monitor and evaluate the health and welfare of all our animals, as well as our antibiotic use, on an ongoing basis. For example, when Jennie-O staff veterinarians determine it's necessary to use an antibiotic to minimize the complications of an illness, they first ensure

antibiotic efficacy against the bacteria causing the disease. To do this, before an antibiotic is prescribed, the team at Jennie-O does additional testing to select an antibiotic that is going to kill the unwanted bacteria. This procedure is called an antibiotic sensitivity test, and it ensures that only antibiotics that will reduce the impact of disease are prescribed.

CONTINUOUS IMPROVEMENT

A great example of our company's continuous improvement is the more detailed information regarding the quantities of antibiotics administered by class in our 2022 report. Also, in the past year Hormel Foods has established a guideline aimed at striving to reduce our overall antimicrobial use by 10% year over year; however, health challenges may arise that could result in the goal not being met during certain years. In addition, we established a target to strive to eliminate the routine use of medically important antibiotics at our Jennie-O Turkey Store farms in 2022 and on our company-owned sow farm by 2025. As part of the 2025 goal, we launched a study in January 2022 with our veterinary partner to identify the changes needed to eliminate the routine antibiotic use.

The commitment of Jennie-O to antibiotic-alternatives research began in 1991 and has continued to generate organizationally specific research on three types of interventions or supportive care supplements: prebiotics, probiotics and essential oils. At its research facility and on farms, the team has conducted 24 studies that pertain to antibiotic alternatives or management practices to help reduce antibiotic usage over the past five years. Those opportunities that have demonstrated value are integrated into the feeding program or are being used as a supportive therapy in the drinking water. (Please see our [white paper](#), published in December 2021 for additional information about our antibiotic-alternatives research efforts.) While the company owns only one sow farm, we are employing similar measures and constantly exploring ways to improve animal health in an effort to eliminate antibiotic use where we can. In addition to supporting the use of antibiotic alternatives in our hog supply, over the past year we've networked with hog producers to understand the interest in production standards, including the CRAU standard, but have yet to be successful in finding a partner.



PARTNERING
WITH
STAKEHOLDERS

In addition to the company’s antibiotic working group and involvement with the National Institute of Antimicrobial Resistance Research and Education membership, in calendar year 2018, Hormel Foods, along with other food companies, retailers, livestock producers and trade and professional associations, announced a comprehensive framework to strengthen stewardship of antibiotic use in food animals. The framework was part of a two-year dialogue with stakeholders, moderated by the Farm Foundation and Pew Charitable Trusts, to ensure that antibiotics are used judiciously throughout production to protect animal and public health.

The 15 core components of the antibiotic stewardship framework are based on the importance of veterinary guidance and partnership, and disease prevention strategies and optimal treatment approaches, as well as effective record-keeping and a culture of continuous improvement and commitment to antibiotic stewardship. The components address education, implementation and evaluation steps for phasing in stewardship programs. The framework’s guiding principles are intended to help ensure that stewardship programs have a clear scientific basis, are transparent, minimize the risk of unintended consequences, encourage alternatives to antibiotics and focus on long-term sustainability.

In the past year, we’ve reviewed the World Health Organization’s (WHO) “Guidelines on Use of Medically Important Antimicrobials in Food-Producing Animals,” and while Hormel Foods is aligned with several key points contained in the guidelines, there are a few notable areas we are seeking to understand more thoroughly. Specifically, those guidelines that WHO has defined as “conditional recommendation[s], with very low-quality evidence,” and the feasibility and potential impacts of implementation, with a focus on animal welfare.

Additionally, we recognize customers and consumers expect more transparency around antibiotic use across all animal-protein sectors, and we are fully engaged and support the voluntary, industry-led antibiotic-use measurement efforts that are already in place. For example, the first comprehensive report on antibiotic use in poultry production was released in August 2019, which has subsequently been updated, followed by a peer-reviewed journal article “Estimates of On-Farm Antimicrobial Usage in Broiler Chicken and Turkey Production in the United States, 2013-2017,”¹ which captures actual practices in the broiler and turkey industries. These reports do not provide specific company data; however, the trends reported include data from the Jennie-O farming operations within the poultry industry report. These reports are important steps in establishing meaningful metrics for the entire turkey industry, and we will continue to support efforts to collect and report data on an industrywide basis.

PRODUCING RAISED-WITHOUT- ANTIBIOTICS PRODUCTS



Hormel Foods has produced raised-without-antibiotics product offerings for many years. The company's Applegate subsidiary is the No. 1 brand in the natural and organic value-added prepared meats category. The Applegate product portfolio is produced entirely from animals raised without antibiotics. If antibiotics are given to an animal, that animal does not enter the Applegate supply chain. When antibiotics are needed to properly care for an animal, only approved medications and dosage levels are used under the direction of a licensed veterinarian. In addition, we offer several raised-without-antibiotics foodservice items, *Columbus*[®] products and *Jennie-O*[®] products.



METRICS

Singularly focusing on one metric, such as milligrams per pound of animal produced, can compromise the integrity of a robust stewardship program. For example, one could impact overall milligrams per pound by substituting a higher-potency antibiotic. Dr. Randy Singer, veterinary epidemiologist, calls attention to this risk by comparing the course of treatment of penicillin and lincomycin for 12,500 turkeys weighing 25 pounds each in the following example:²

	Penicillin	Lincomycin
Active antimicrobial per pack	1.0 billion IU/pack	192 g/pack
Gallons of water per pack ^a	666 gallons/pack	3,000 gallons/pack
Number of packs of antimicrobial ^b	27 packs	6 packs
Total IU	27,000,000,000 IU	N/A
Total active drug (g) ^c	- 16,927.2 g	1,152 g
Active antimicrobial per bird	1,354.2 mg/bird	1,152 mg/bird
Active antimicrobial per kg body weight (BW) at time of treatment	119.4 mg/kg BW	8.1 mg/kg BW
Active antimicrobial per kg treated BW per day	17.1 mg/kg BW/day	1.2 mg/kg BW/day
Days of animal therapy (five-day duration of treatment)	87,500	87,500
Therapeutic regimens (number of birds treated)	12,500	12,500

^a Each antimicrobial is administered according to label instructions (U.S. Food and Drug Administration, 2020a).

^b Number of packs of antimicrobial needed is rounded up, as the entire pack must be mixed into the stock solution.

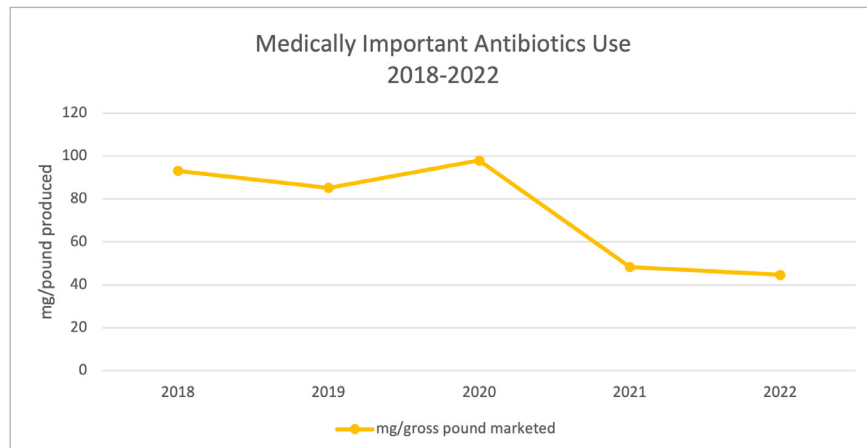
^c Conversion used for penicillin G procaine is 1,595,066 IU/g.

Even though the number of birds treated and duration of treatment are the same in the example above, the total grams of penicillin given are 14.7 times higher than the grams of lincomycin administered due to the lower potency of penicillin.¹ What this scenario demonstrates is that a single metric, such as milligrams per pound of animal produced, is greatly impacted by the antibiotic that is chosen and that a broader commitment to overall stewardship, not just measurement, is necessary to have an impact on antimicrobial resistance.

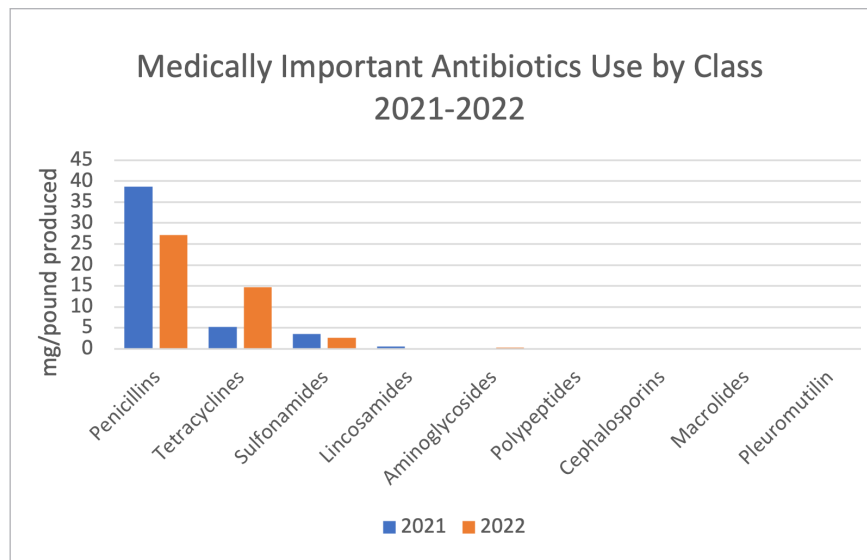
TURKEY DATA

Antibiotic administration data, including details about antibiotic class, was collected from the Jennie-O network of company and contract farms (see Graphs 1 and 2). This group of farms represents more than 75% of the Jennie-O turkey supply. The Jennie-O farming system also produces approximately 140 million pounds of raised-without-antibiotics turkey. Any turkey flocks that received antibiotics are disqualified from the raised-without-antibiotics program and are included in the data below.

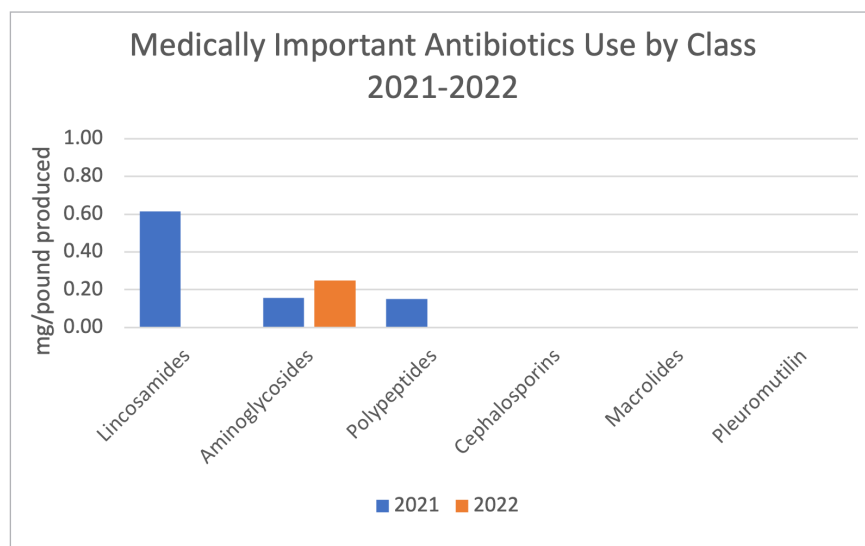
Graph 1: The following graph shows the medically important antibiotics use for our Jennie-O farm system from 2018–2022.



Graph 2: The following graph shows the medically important antibiotics use by class for our Jennie-O farm system and our contract growers in 2021 and 2022.



Graph 2a*: The following graph shows the medically important antibiotics with minor use by class for our Jennie-O farm system and our contract growers in 2021 and 2022.



*Adjusted Y axis.

DISCUSSION

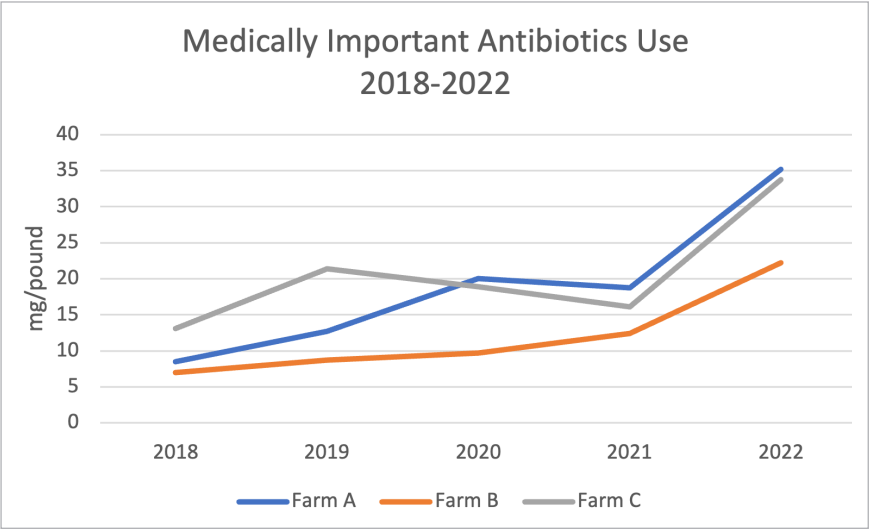
The Jennie-O network of farms reduced antibiotic use by 8% year over year, missing the company target of 10%. However, there has been a greater than 50% reduction in the last three years without compromising the welfare of the birds in its care. In 2021 and 2022, the veterinarians and farm team at Jennie-O focused on alternative methods for reducing and controlling clostridial dermatitis. This disease is typically treated with penicillin, a low potency antibiotic and a major contributor to overall antibiotic use at Jennie-O. As a result of the team’s efforts, penicillin use was cut in half, which continues to be critical, considering the ongoing penicillin shortage being experienced throughout the industry.

While the overall trend was a reduction in use, there were some changes within the antibiotic classes. In addition to penicillin, as mentioned above, sulfadimethoxine shortages were a challenge in 2022. With sulfa antibiotics in short supply, veterinarians opted to treat cases of *E. coli* and other bacterial infections with tetracyclines – specifically oxytetracycline in the drinking water. Neomycin, an aminoglycoside antibiotic, use increased due to a rise in bacterial enteritis (i.e., intestinal inflammation) in young poults. Rates of enteritis increased after utilizing a coccidiosis vaccine for a large portion of the year. Coccidiosis is a disease caused by intestinal pathogens to which all birds are exposed. The coccidiosis vaccine is used to moderate the degree of disease caused by the field strains of cocci, but the vaccine itself causes intestinal inflammation, increasing the risk for bacterial enteritis.

PIG DATA

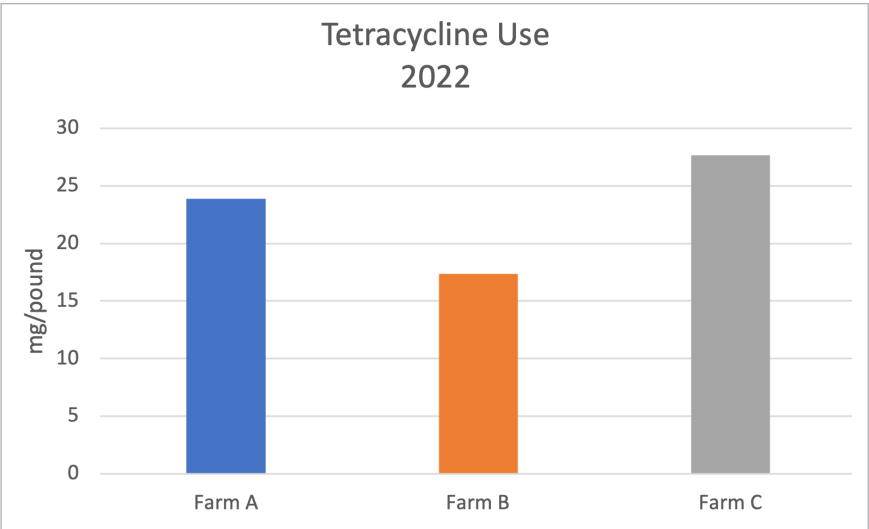
When Hormel Foods made the commitment to report antibiotics administered to the animals in our supply chain, there was very little guidance on how to best capture antibiotic use throughout the life cycle of a pig. Unlike Jennie-O, which is highly integrated, our pork supply chain relies on a large collection of producers with varying levels of integration. As Hormel Foods has one company-owned sow farm, we launched a pilot project in 2019, working with farm partners from four representative systems to collect antibiotic administration data. Three of the systems support the Hormel Foods enterprise (see Graphs 3 through 7), and one supported Applegate but has since left its supply chain; therefore, it's not included in this year's report. In total, the data in the following graphs represents approximately 660,000 market hogs. Additionally, data collected from our single company-owned sow farm is presented separately (see Table 1 and Graph 8).

Graph 3: Total of medically important antibiotics used per pound produced for three Hormel Foods hog supplier systems from 2018-2022.

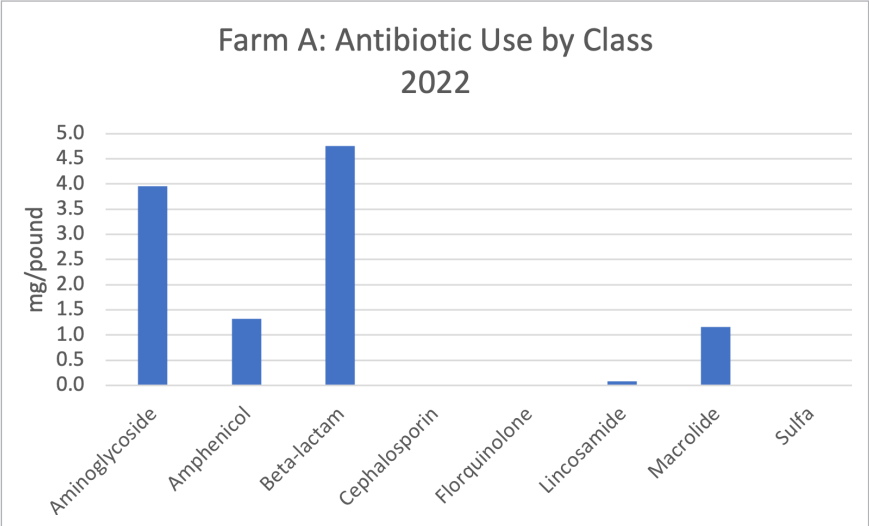


Note: The live weight calculated was based on a 75% carcass yield. Pigs were cohorted based on when they started on feed, so the mg/lb use for a given month is reflective of what those market hogs received.

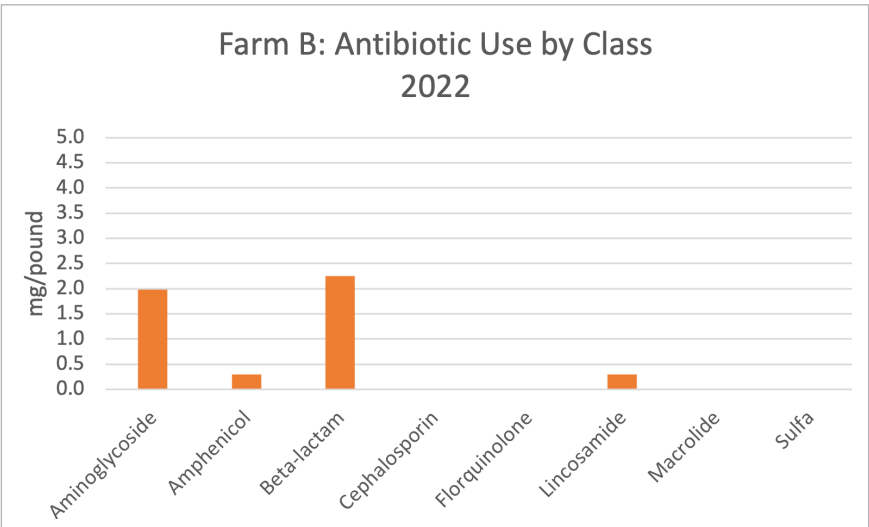
Graph 4: Tetracycline use across three farm systems



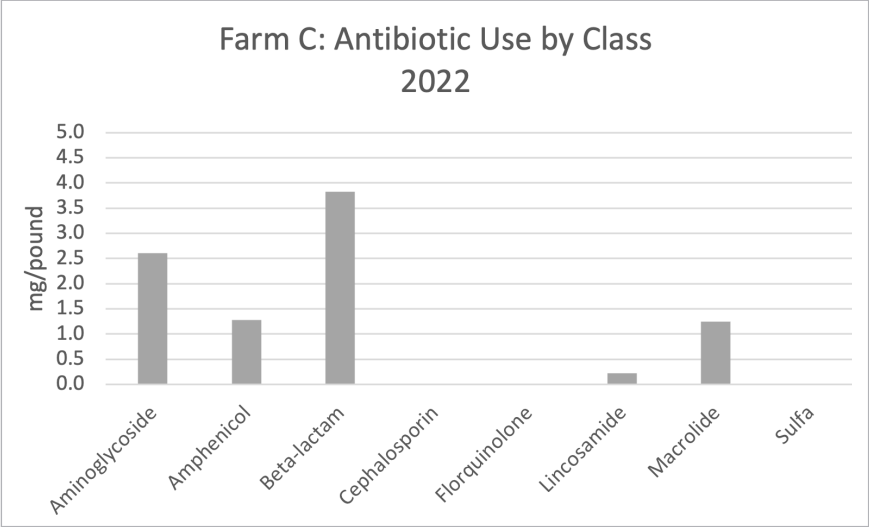
Graph 5: Detailed antibiotic use by class – Farm A



Graph 6: Detailed antibiotic use by class – Farm B



Graph 7: Detailed antibiotic use by class – Farm C



DISCUSSION

The quantities of antibiotics administered and captured in the pig data in Graphs 3 through 7 include offspring from both porcine reproductive and respiratory syndrome (PRRS) positive and negative herds. PRRS is a viral disease very common in sow herds in the United States, and it can impact the sows (reproductive and respiratory effects) and the piglets (respiratory effects). We sought to make the data collected in this report as representative as possible by including PRRS-positive pigs. Excluding them would have likely decreased the represented quantities of antibiotics administered but would not have been reflective of the supply chain overall.

All three groups of farms were significantly impacted by PRRS in 2022, and while PRRS is a viral disease, hogs infected with PRRS are much more susceptible to bacterial infections, leading to an increase in antibiotic use for all three groups in 2022. Tetracycline was the most-used antibiotic to address secondary bacterial infections across all three groups in 2022.

More specifically for Farm A, the sow herd was minimally impacted by the PRRS challenge. However, the strain caused prolonged fever in weaned pigs, which made them susceptible to bacterial infection. In addition to the previously mentioned tetracycline use, beta-lactamase was used to specifically address streptococcus infections. With the large disease pressure present, the producer has opted to draw down the current herd and repopulate with animals with a high health status. This is a significant financial investment for the producer and will take well over a year to complete.

The sows on Farm B have maintained their high health status, including remaining PRRS negative. While sow health remained stable, offspring typically were raised in hog-dense areas with PRRS present – leading to higher rates of PRRS positivity in the offspring of Farm B and subsequent increases in bacterial infection and antibiotic use.

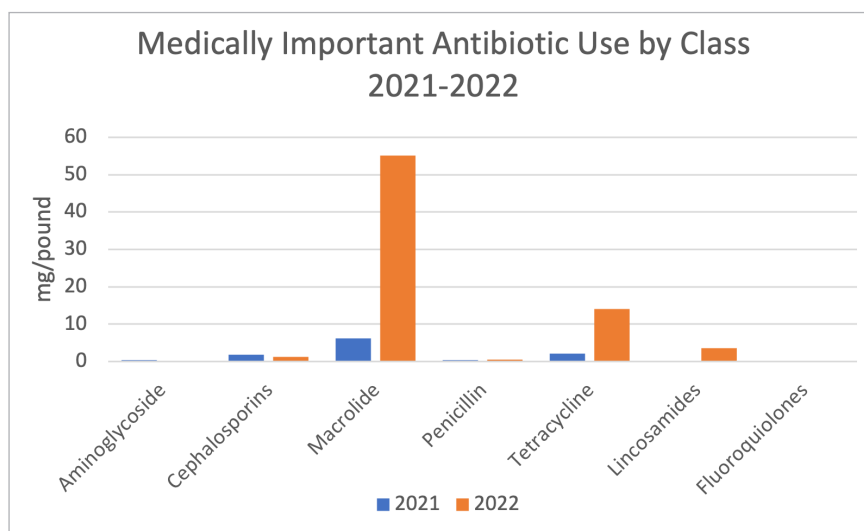
Sourcing of gilts was a challenge for Farm C in 2021 and 2022, with an unprecedented three sources being used in less than 18 months. These changes were all related to PRRS challenges on the various source farms.

Mixing sources of animals makes managing health outcomes very challenging, and this is reflected in the upward trend of antibiotic use. With all these challenges, the producer and partnering veterinarian are exploring their strategic options for improving and stabilizing herd health on this group of farms.

Table 1: The following table shows the medically important antibiotics use at our only company-owned sow farm from 2018 to 2022.

	2018	2019	2020	2021	2022
Sows mg/pound (injectable)	3.76	2.96	2.89	1.0	4.98
Sows mg/pound (feed)	20.52	66.70	88.82	6.71	66.9
Piglet mg/pound (injectable)	0.73	0.53	0.61	3.65	2.95

Graph 8: Medically important antibiotic use by class at our only company-owned sow farm from 2021 to 2022.



The increase of in-feed antibiotic administration in 2022 at the company’s sow farm, summarized in Table 1 and Graph 8, is related to a PRRS instability in the herd. Due to active PRRS infection in the sow herd, piglets were at a higher risk for developing disease. A macrolide antibiotic was also prescribed to reduce the impact of post-weaning bacterial pneumonia. The increase in tetracycline use is the result of medicating one of the diets within the gilt development site to reduce secondary bacterial pneumonia related to PRRS virus circulation. The gilts are eating well at this stage of development, so there’s a high rate of feed consumption and along with it, medication. In partnership with our consulting veterinarian, we continue to evaluate our strategies to minimize the impact of PRRS on herd health in order to reduce the need for antibiotic administration.

Independent of PRRS control, in 2022 on our company-owned sow farm we were able to improve health outcomes in our herd in several ways. Our team was able to eliminate *mycoplasma hyopneumoniae*, a pathogen that is highly contagious and can cause chronic disease in pigs. Thus, we instituted a *streptococcus suis* vaccine. *S. suis* is a bacterium that can cause a wide variety of disease presentations in pigs. On top of specific disease mitigations, we increased the focus on sanitation in farrowing to help with overall piglet health.



CONCLUSION

As demonstrated throughout this report and in our publicly documented efforts, Hormel Foods is committed to the transparency of its antibiotic stewardship efforts. To protect animal and human health, we must all remain vigilant stewards of antibiotics. Continual refinement of management and preventive medicine programs, engagement with veterinary experts and a commitment to continuous improvement are all critical principles of our antimicrobial stewardship program. While antimicrobial use is one metric reflected in this report, measurement as the sole index should not be the only criterion by which comprehensive stewardship programs are measured. This report not only captures antibiotic use from the various facets of our supply chain, it demonstrates the commitment of our company to improving antibiotic stewardship through a multifaceted approach.

Please email globalimpact@hormel.com if you have any questions or feedback about this report. For more information about our corporate responsibility initiatives, including our environmental stewardship and charitable giving efforts, please refer to our global impact report.

¹As defined in the "Critically Important Antimicrobials for Human Medicine: 6th Revision" by the World Health Organization. Routine use means antibiotic use for disease prevention purposes. For example, treating all animals in a flock or herd at a certain time as a regular practice (such as at weaning or before shipping) is by definition routine use even if administered by injection to individual animals of that flock or herd. In addition, antibiotics delivered through animal feed, water, injectable or any other delivery mechanism, to a group of animals that has not been diagnosed with a transmissible bacterial infection is considered "routine use."

²Randall S. Singer, Leah J. Porter, Nora F. D. Schrag, Peter R. Davies, Michael D. Apley, Kathe Bjork. Estimates of on-farm antimicrobial usage in turkey production in the United States, 2013–2017. *Zoonoses and Public Health*, 10.1111/zph.12763, 67, S1, (35-50), (2020).

