



THE NATIONAL  
INSTITUTE FOR  
ANIMAL AGRICULTURE

# WHITE PAPER



12<sup>TH</sup>

# ANTIBIOTICS SYMPOSIUM

Exploring Stewardship, Sustainability & Collaboration

NOVEMBER 1-3, 2022  
ALEXANDRIA, VA

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# Background

The 12<sup>th</sup> Annual Antibiotics Symposium, “Exploring Stewardship, Sustainability, and Collaboration”, hosted by the National Institute for Animal Agriculture (NIAA) was held in-person in Alexandria, VA on November 1-3, 2022. In attendance were participants representing a broad range of stakeholder groups, including state and federal government, academia, veterinarians, producers, producer organizations and cooperatives, food retailers, animal health manufacturers and retailers, trade organizations, agricultural marketing, and non-profit organizations.

The NIAA is a non-profit, membership-driven organization that unites and advances animal agriculture for the challenges facing animal agriculture industries (aquatic, beef, dairy, equine, goat, poultry, sheep and swine). NIAA is dedicated to furthering programs for the eradication of diseases that pose risk to the health of animals, wildlife and humans; promoting the efficient production of a safe and wholesome food supply for our nation and abroad; and promoting best practices in environmental stewardship and animal health and well-being.

The 2022 12<sup>th</sup> Annual Antibiotics Symposium was funded in part NIAA partners.

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## **Symposium Purpose and Design**

The 2022 Antibiotics Symposium, “Exploring Stewardship, Sustainability, and Collaboration” is a continuation of a conversation that began in 2011. Though animal agriculture is a common theme, this symposium connects leaders across all aspects of animal production, food processing, animal health, human health, and environmental health to provide an opportunity for collaboration to improve the future of antimicrobial resistance research, education, and communication.

## **Symposium Planning Committee**

### **Antibiotics Council Co-Chairs**

- Dr. Megin Nichols – Centers for Disease Control and Prevention
- Dr. Justin Welsh – Merck Animal Health

### **Symposium Planning Committee Members**

- David Bruene – Iowa Cattle Rancher, Cattlemen’s Beef Board
- Dr. Heather Fowler – National Pork Board
- Abraham Kulungara - Association of State and Territorial Health Officers
- Dr. Paul Plummer – National Institute for Antimicrobial Resistance Research and Education
- Dr. Hayley Springer – Penn State University
- Courtney Youngbar – Association of State and Territorial Health Officers

## **Symposium Topics and Speakers**

### **Welcome and Introductions**

Dr. Eric Moore – Norbrook, Inc.

Dr. Megin Nichols – The Centers for Disease Control and Prevention

Dr. Jeffery Silverstein – USDA, ARS

### **The State of Sustainability in Today's Food System – How does One Health fit in?**

Dr. Heather Fowler – National Pork Board

Jon Hixson – Yum! Brands

### **Connecting Sustainability and One Health**

Laurie Hueneke (moderator) – Merck Animal Health

Dr. Christi Calhoun – Zoetis

Fabian Bernal – DeLaval

Ryan Bennett – U.S. Roundtable for Sustainable Poultry and Eggs and the International Poultry Welfare Alliance

### **Regulatory Updates... How do we work together in a One Health way?**

Food and Drug Administration (FDA) – Dr. Amber McCoig

Centers for Disease Control and Prevention (CDC) – Dr. Jason Folster

USDA Animal and Plant Health Inspection Service (APHIS) – Dr. Chelsey Shivley

USDA Agricultural Research Service (ARS) – Dr. Steve J. Moeller

Environmental Protection Agency (EPA) – Smiti Nepal

National Institutes of Health (NIH) – Dr. Kyung Moon

### **The Meat Consumer of Tomorrow: Antibiotics, Inflation, and Beyond**

Michael Uetz – Midan Marketing

### **Antibiotics. One tool in the toolbox... what else are farmers, ranchers, and veterinarians using to care for animals?**

Dr. Tom Noffsinger – Independent feedlot consultant

### **Antibiograms: Stepping into the Future of Veterinary Antibiotic Stewardship**

Dr. Edie Marshall – California Department of Agriculture

### **New veterinary medicine: OTC to RX**

Joe Huffine – ProTriton

## **Global Perspectives on Antimicrobial Resistance and Use Policies**

Dr. Rachel Cumberbatch – Animal Health Institute

## **Stewardship – Research to Practice**

Dr. Terry W. Lehenbauer – Veterinary Medicine Teaching and Research Center – UC Davis

## **Exploring the Potential for a Public-Private Partnership to Support the Tracking and Monitoring of Antimicrobial Use in Food-Producing Animals**

Dr. Amar Bhat – Regan-Udall Foundation

## **Breakout Sessions – Communication**

Led by:

Beka Wall – Cattlemen’s Beef Board

Jason Menke – National Pork Board

## **Breakout Sessions – Research**

Led by: National Institute of Antimicrobial Resistance Research and Education (NIAMRRE)

Dr. Paul Plummer

Kris Johansen

Erika Baker

Sara Al-Mazroa Smith

## **Breakout Sessions – Education**

Led by: American Farm Bureau Foundation for Agriculture

Brian Beierle

Yolanda Payne

## Executive Summary

With the introduction of the term “zoonosis” by Dr. Rudolf Virchow (MD) in the 19<sup>th</sup> century, and the later advent of the term “One Medicine” by Dr. Calvin Schwabe (DVM, ScD, MPH), the intimate ties between human and animal health have long been recognized<sup>1</sup>. The term “One Health” then emerged in the early 2000s, signifying that these interrelationships exist not only between human and animal health but also with environmental health<sup>1</sup>.

These three pillars of One Health intersect closely in the animal agriculture industry. The National Institute for Animal Agriculture (NIAA) can trace its roots back to the Livestock Conservation Institute, an organization established in 1916 to explore and address livestock-related zoonotic disease. Today, the NIAA is still dedicated to addressing the risks of zoonotic disease, and has developed a particular focus on antimicrobial resistance. At the NIAA’s in 2022, entitled “Exploring Stewardship, Sustainability, and Collaboration,” the presentations and discussions highlighted the importance of antimicrobial stewardship for the sustainability of the livestock industry.

The symposium began by exploring sustainability in the food system and the ties between sustainability and One Health. Every animal lost to disease reduces the sustainability of animal agriculture by increasing the amount of land, labor, and other inputs required per unit of product. Antimicrobial stewardship efforts aimed at reducing not only the use of antimicrobials, but also the need for antimicrobials, are inherently designed to improve animal health. For example, production stockmanship improves animal health by improving animal care. Good stockmanship reduces animal stress, which correspondingly reduces the negative impacts of stress on the immune system and thereby allows the animal to better resist disease.

Reducing disease-related losses by improving animal health also benefits humans by providing improved food security and a reduced risk of zoonotic disease. From the One Health perspective, improvements in antimicrobial stewardship will improve agricultural sustainability while supporting the health of animals, humans, and the environment. Investors are increasingly recognizing and favoring sustainability in animal agriculture, further increasing the economic value of sustainable agricultural practices such as antimicrobial stewardship.

The NIAA's antibiotics symposium connects stakeholders from across the industry as well as multiple government organizations with a vested interest in animal agriculture. Attendees included representatives from the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS), USDA Agricultural Research Service (ARS), the Environmental Protection Agency (EPA), and the National Institutes of Health (NIH). Symposium participants had the opportunity to not only hear updates from each organization but also to ask questions and learn about how the different agencies interact. Speakers and participants discussed domestic policies as well as the importance of monitoring global trade and antimicrobial use policies.

The conference highlighted several recent developments and success stories related to One Health and antimicrobial stewardship in animal agriculture. For example, the FDA shared that the animal health industry was voluntarily complying with efforts to improve veterinary oversight of medically important antimicrobials. This is an important step in improving animal stewardship, but it could also bring challenges to the retail side of the industry as both retailers and producers adapt to the changes. California has required veterinary oversight of medically important antimicrobials for several years now and has invested in tools like antibiograms to continue improving their stewardship. Antibiograms, which summarize susceptibility data for a given species and pathogen, can provide valuable information for both determining an appropriate empiric antibiotic treatment and monitoring trends in antimicrobial resistance. Another valuable tool for improving antimicrobial stewardship is antimicrobial use data, but building an acceptable system to track antimicrobial use has been difficult. The Regan-Udall Foundation has taken on this challenge: the foundation is currently developing the framework for a public/private partnership that could effectively capture antimicrobial use data while protecting the privacy of participating producers and veterinarians.

Focused breakout sessions at the NIAA symposium captured the wide variety of expertise of symposium participants. The communication breakout session allowed participants to collaboratively build ideas to engage consumers and share the story of animal agriculture. Outcomes from the research breakout session will help the National Institute of Antimicrobial Resistance Research and Education guide future antimicrobial alternatives research. In the education breakout session, participants discussed their plans to help build a teacher fellowship program currently being



developed by the American Farm Bureau Foundation for Agriculture in collaboration with the NIAA. This fellowship program will help educators teach science concepts through an animal agriculture lens. To conclude the symposium, participants gathered in small groups to reflect on their key takeaways. The word cloud on the following page shows some of the most common themes shared by participants and clearly reflects the goals of the 12<sup>th</sup> Annual NIAA Antibiotics Symposium: Exploring Stewardship, Sustainability, and Collaboration.



## The State of Sustainability in Today's Food System – How does One Health fit in?

A unique aspect of the One Health concept is that no single individual can be the sole expert a question. One Health is built on cross-discipline collaboration, requiring that multiple participants with multiple areas of expertise work together to build solutions to complex problems. Though the idea of One Health was originally rooted in infectious disease, sustainability is becoming an increasingly important component of the One Health concept. Indeed, the recently published definition of “One Health,” developed by the One Health High-Level Expert Panel convened by the One Health Commission, clearly incorporates sustainability into One Health:

“One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent<sup>2</sup>.”

The One Health approach mobilizes multiple sectors, disciplines, and communities at varying levels of society to work together to foster improved well-being and reduce or minimize threats to ecosystems and health. At the same time, these multidisciplinary teams address the collective need for clean water, energy, air, and safe and nutritious food. They also take action on climate change and promote sustainable development.<sup>2</sup>

Although “One Health” and “sustainability” are relatively modern terms, their principles are already ingrained in animal agriculture. For example, the National Pork Board’s “We Care” ethical principles<sup>3</sup> encompass the environment, food safety, animal well-being, the people in the industry, the local community, and public health, all of which map back not only to One Health principles but also to the United Nations Sustainable Development Goals<sup>4</sup>.

Despite great progress in antimicrobial stewardship and sustainability thus far, future success in these areas will require ongoing collaboration. Farm owners, industry professionals, scientists, and government agencies must work together to develop effective solutions that can be realistically implemented in the animal agriculture industry. For example, more research will be needed to continue making advances in stewardship and sustainability. To reduce antimicrobial use

effectively and sustainably, stewardship must focus on reducing the need for antimicrobials. However, there are multiple routes to this goal: improving animal health, changing animal housing, or developing antimicrobial alternatives can all reduce antimicrobial use. By working collaboratively, stakeholders can identify which of these are the most impactful targets for future research.

Reducing the need for antimicrobials will naturally reduce the amount of antimicrobials used, but quantifying the magnitude of this reduction on a species-by-species basis will be critical for tracking and showcasing the impact of stewardship practices over time. This information will provide important success stories that can be shared with consumers and investors. With a combination of targeted research, accurate data on antimicrobial use, and a message of stewardship, sustainability, and responsible and ethical animal production, the animal agriculture industry can continue to build consumer confidence.

**Resource:**

- [UN Sustainable Development Goals](#)

## Connecting Sustainability and One Health

Sustainable development is frequently defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”<sup>5</sup>. This forward-thinking approach to development has become increasingly important in all aspects of business. Although recent changes in animal agriculture have primarily been driven by consumers or activists, sustainable development is increasingly being driven by investors. In 2005, a collaborative group of international financial institutions organized by the United Nations (UN) published the “Who Cares Wins” report, which provided recommendations for how to integrate environmental, social, and corporate governance (ESG) issues into financial decision-making processes<sup>6</sup>.

The extent to which a company has achieved ESG initiatives can be quantified using ESG scores or ratings. Companies with higher ESG scores typically report higher employee satisfaction, and this relationship will likely become stronger as millennials become the bulk of the workforce. ESG ratings are also positively correlated with corporate financial performance<sup>7</sup>. The intangible assets of companies, such as their reputation, are becoming an increasingly important component of corporate valuation. Reputation is directly tied to funding, and ESG ratings are correspondingly becoming an important determinant of access to funding. Sustainability will therefore be a key aspect of continued growth in animal agriculture.

Carbon credits are another business-related aspect of sustainability in agriculture. Some people fear that large corporations will simply buy their way to carbon neutrality rather than implement sustainable practices; however, carbon reductions can come from all aspects of the supply chain. Agriculture may also benefit from offsetting carbon production for other industries. Nevertheless, despite the concerns and potential opportunities with the carbon credit model, the carbon credit market remains in its infancy. The long-term effects of carbon credit trading on the animal agriculture industry will only be seen once the system and the legislation surrounding it mature.

The UN Sustainable Development Goals (SDGs) are another way to guide sustainability initiatives on a global scale<sup>4</sup>. For example, Health for Animals released a report, entitled “Achieving the Sustainable Development Goals: The Value of Healthier Animals,” that clearly ties animal health to the UN SDGs<sup>4</sup>. Indeed, livestock are critical to human health and food security, but 20% of livestock are lost to

disease, increasing the environmental footprint of animal protein production<sup>8</sup>. Improving animal health therefore plays an important role in environmental sustainability.

Another important aspect of sustainability in animal agriculture is antimicrobial stewardship. Stewardship efforts should begin well before disease onset. For example, improvements in animal health can begin even before birth by selecting for disease resistance or other health-related traits. Preventative practices, including proper animal housing and management as well as appropriate use of animal health products such as vaccines, also play a vital role in antimicrobial stewardship and overall sustainability.

Although disease prevention should be the top priority, animals will still get sick. With rapid diagnostics, modern sensor technology, artificial intelligence, and data analytics, sick animals can be identified more quickly and isolated from other animals. When treatment is necessary, veterinarians should be involved in the decision to administer antibiotics and, where possible and appropriate, use alternative non-antimicrobial therapies. Early detection and appropriate treatment will ultimately speed recovery and minimize antimicrobial use, further promoting sustainability in animal agriculture.

The ties between sustainability and antimicrobial stewardship were clear to the participants at this year's NIAA symposium, but this relationship might be confusing for some consumers. Sustainability is often expressed as cost per output, or efficiency. However, discussions that cover both antimicrobial use and production efficiency typically center on the use of antimicrobials for growth promotion, a practice that is antithetical to antimicrobial stewardship. To avoid creating any confusion among consumers, the animal agriculture industry needs to communicate a clear message of proactive prevention, while recognizing that livestock do get ill and need antimicrobial treatment at times. By helping consumers understand the impact of various production methods on animal health, animal wellbeing, antimicrobial stewardship, and sustainability, the industry can help consumers make more informed decisions when choosing a product or vendor.

Assessing the effectiveness of sustainability efforts and determining the optimal next steps will inevitably require enormous amounts of data. Agriculture will therefore need to invest in improvements in data quality, normalization, and management to effectively capture the information needed to improve sustainability. For example, new technologies provide great opportunities to

improve animal health, sustainability, and stewardship. As new technology is implemented, rural infrastructure will also need to be improved to effectively capture these opportunities. Overall, a One Health approach with a focus on communication, collaboration, and connectivity will be critical for continuing to improve sustainability and stewardship in animal agriculture.

**Resources:**

- [Achieving the Sustainable Development Goals: The Value of Healthier Animals](#)
- [Who Cares Wins: Connecting Financial Markets to a Changing World](#)
- [ESG and Financial Performance](#)

## **Regulatory Updates... How do we work together in a One Health way?**

### **Food and Drug Administration (FDA)**

The FDA Center for Veterinary Medicine (CVM) is nearing the end of the five-year stewardship plan it released in 2018. One key goal of this plan was evaluating the use conditions for approved antimicrobial products, including the duration of use of medically important in-feed antimicrobials. The CVM has recently published a concept paper related to this objective and will be accepting comments to further refine the document.

The CVM's five-year plan also focused on promoting stewardship at the user level, which was accomplished through the implementation of Guidance for the Industry (GFI) initiatives #213<sup>9</sup> and #263<sup>10</sup>. The former initiative brought medically important in-feed antimicrobials under veterinary supervision in 2017 by transitioning them to veterinary feed directive status. The latter will bring all remaining over-the-counter (OTC) medically important antimicrobials under veterinary supervision by June 2023. This latter objective will be achieved by transitioning approximately 90 OTC products to prescription status.

Another goal of the CVM's five-year stewardship plan was to collect data on antimicrobial use and resistance. Sales data and information from the CDC's National Antimicrobial Resistance Monitoring System (NARMS) currently provide the bulk of use and resistance data, but antimicrobial sales and antimicrobial use are not always strongly correlated. The CVM therefore entered a cooperative agreement in 2016 to identify the best methods for collecting antimicrobial use data and then pilot these methodologies. The CVM is currently exploring a public-private partnership with the Regan Udall Foundation to build a system that tracks antimicrobial use in a manner that is useful for both stewardship and regulation but still protects data privacy. This partnership was described in more detail in another symposium session.

Finally, the CVM is working on updates to GFI #152<sup>11</sup>, which was initially finalized in 2003. This piece of guidance ranks antimicrobials based on their importance in human medicine. In 2020, the CVM published a concept paper describing methods for re-assessing a compound's importance in human medicine, and draft guidance is expected by early 2023. Overall, the FDA has implemented important changes in

the last few years that focus on improving antimicrobial stewardship. Their future work will continue to address antimicrobial stewardship with an emphasis on stakeholder engagement.

## **Centers for Disease Control and Prevention (CDC)**

The CDC's most recent publication on antimicrobial resistance explores the impact of COVID-19 on antimicrobial resistance<sup>12</sup>. The pandemic affected the eating patterns of many Americans and, in doing so, likely altered the typical patterns of foodborne disease. However, there is limited data on foodborne diseases during the pandemic because people were also less likely to visit healthcare facilities for minor illness. The CDC notes that it is therefore difficult to determine how the pandemic affected antimicrobial resistance in foodborne diseases.

Recent stewardship initiatives at the CDC include prioritizing prevention and fighting resistance where it occurs, both within the food system and the broader environment. The CDC is involved in several partner projects targeting drug resistance and use in companion animal and equine pathogens, as well as a program with Ohio State University assessing salmonella in feed components and pet treats. The CDC is also developing educational materials for pet owners and feed mills and has launched a global antimicrobial resistance monitoring system to better monitor resistance abroad.

The CDC's NARMS program continues to provide domestic data on antimicrobial resistant pathogens. Recent updates to the 'NARMS Now' interactive tool include providing minimum inhibitory concentration (MIC) distributions and prevalence of genetic determinants of resistance for these pathogens.

In May 2022, the CDC launched a new alert system to identify emerging strains of resistant pathogens and plasmids of concern. One example of an emerging multi-drug resistant organism being tracked by this new system is *Salmonella* Kentucky ST198, which was first reported in Africa. This strain has since been identified in the U.S., but most strains are still associated with international travel. The CDC's alert system continues to monitor for domestically acquired cases. The alert system is also tracking the pESI plasmid of *Salmonella* Infantis. This plasmid harbors genes conferring antimicrobial, heavy metal, and antiseptic resistance, as well as genes for fimbriae and iron acquisition. Although *S. Infantis* strains carrying the pESI plasmid have infected humans, *S. Infantis* is not particularly virulent; the bigger concern is the potential for this plasmid to transfer to other, more pathogenic strains. The



CDC's alert system will continue to provide the data needed to rapidly respond to the multi-drug resistant organisms of concern that are being monitored by NARMS.

## **USDA Animal and Plant Health Inspection Service (APHIS)**

The National Animal Health Monitoring Service (NAHMS), a subdivision of USDA-APHIS, tracks antimicrobial use, stewardship, and, in some surveys, susceptibility. Most recently, NAHMS is wrapping up its "Cow-calf 2017" and "Goat 2019" projects, both of which included all three components of antimicrobial resistance data. In addition, the NAHMS is currently performing studies in the swine industry (both large and small enterprise) and a feedlot, with the goal of tracking changes in antimicrobial use and stewardship since the 2016 versions of these studies. Results from these new studies will provide valuable information on how the transition of medically important in-feed antimicrobials to veterinary feed directive status has affected these industries.

NAHMS studies generally provide information on antimicrobial-resistant organisms found in healthy animals, but USDA-APHIS has also implemented a nation-wide monitoring system to provide data on animal pathogens from diagnostic cases. This monitoring system, operated in collaboration with the National Animal Health Laboratory Network (NAHLN), is the first opportunity for the animal health community to track trends in antimicrobial resistance in diagnostic isolates at the national level. Up-to-date results are provided through an interactive online dashboard. Although the current project was only developed as a pilot, the USDA expects this monitoring program to continue.

In addition to monitoring, USDA-APHIS provides educational outreach through its veterinary accreditation program. The veterinary accreditation modules cover a variety of animal health topics, including the veterinary feed directive, judicious use of antimicrobials, and honeybee medicine. APHIS is also working to develop infographics and other short-format materials to communicate stewardship messaging to producers, an audience not typically reached by the current USDA-APHIS reports.

External collaborations are also driving advances in antimicrobial stewardship. For example, APHIS has provided financial and analytical support for a project with Pipestone Veterinary Service that simultaneously monitors antimicrobial use in client herds and tracks resistance in swine and major pathogens. Another collaborative project, based in New York, has leveraged the expertise of behavioral

scientists to identify the best communication methods to effect behavioral changes in antimicrobial stewardship on farms. Future stewardship efforts at USDA-APHIS include revisiting the antimicrobial resistance action plan, providing new resistance-related funding opportunities, and expanding beyond food animals to include both wildlife and companion animals in stewardship initiatives.

## **USDA Agricultural Research Service (ARS)**

The USDA-ARS continues to provide non-regulatory, intramural research across a wide range of agricultural-related topics in four main program areas: (i) animal production and protection, (ii) crop production and protection, (iii) natural resources and sustainable agriculture systems, and (iv) nutrition, food safety, and quality. The ARS's past accomplishments in antimicrobial resistance and antimicrobial alternatives research are summarized in their recent multi-year reports.

Looking ahead, the ARS is currently overseeing over 90 research projects, spanning all four of its program areas, that are focused on antimicrobial resistance and antimicrobial alternatives. Future research directions are being driven by stakeholder engagement, and funding has been allocated to both long-term projects and complementary short-term projects. At a recent planning meeting that included all four program areas, commodity groups, and other stakeholders, the ARS developed a mission statement and identified needs for continued research related to antimicrobial resistance. This future research will focus on understanding risk, improving diagnostics and detection, building mitigation strategies, and developing science outreach programs.

## **Environmental Protection Agency (EPA)**

With the implementation of its Surface Water Antimicrobial Resistance Monitoring (SWAM) program, the EPA has become the newest member of NARMS. The objectives of SWAM are to develop a standardized measure for assessing trends in antimicrobial resistance in waterways, provide input data for assessing the antimicrobial resistance risks of end uses of water, quantify drivers of resistance, and identify critical control points that could be targets for mitigation strategies. The SWAM program is currently in pilot stages to determine appropriate sampling strategies, reporting metrics, and data quality objectives. The current pilot program is tracking antimicrobial resistance in a single watershed using culture-based assessments, targeted gene analysis, and metagenomics. As SWAM is implemented more broadly across the landscape, the EPA can leverage its National Rivers and

Streams program, which assesses water quality on a national scale. In addition to refining and expanding SWAM, future work at the EPA will include developing risk assessment models to improve end uses of data and linking SWAM to other monitoring programs within EPA.

## **National Institutes of Health (NIH)**

The NIH is the world's largest funder of biomedical research. Within the NIH, the National Institute of Allergy and Infectious Disease (NIAID) takes the lead on antimicrobial resistance research. An important aspect of the NIAID's antimicrobial resistance research is non-traditional approaches, including the development of vaccines and non-antimicrobial treatment modalities. For example, antiviral vaccines provide indirect benefits to antimicrobial stewardship by reducing secondary infections and the subsequent need for antimicrobials. Bacterial vaccines provide direct benefits by reducing susceptibility to pathogens that are typically treated with antimicrobials. Beyond these preventative measures, the NIAID is also researching the use of bacteriophages or microbiome-based therapeutics to treat bacterial disease. Although NIH research focuses on human health, there are many opportunities for cross-species application of these research findings. Vaccines, non-traditional therapeutics, and diagnostic tools that speed pathogen detection and rapidly identify antimicrobial susceptibility can be readily translated to animal medicine.

### **Resources:**

- [Antimicrobial Resistance & Alternatives to Antimicrobials Webinar Series](#)
- [NARMS Now: Integrated Data](#)
- [COVID-19 U.S. Impact on Antimicrobial Resistance](#)
- [USDA APHIS NAHLN AMR Pilot Project](#)

## **The Meat Consumer of Tomorrow: Antibiotics, Inflation, and Beyond**

Within the animal agriculture industry, the consumer is often referred to as a single entity, but not all consumers think and act alike. Based on its interactions with consumers, Midan has divided meat consumers into five distinct groups. This division helps producers and marketers understand how to best target each group and impact their behavior.

The most common consumer is the “Convenience Chasers,” which account for around one-third of all meat consumers. Convenience is a major driver for these busy, price-conscious consumers seeking quick and easy meal options.

The next three groups of meat consumers each account for roughly 20% of all meat consumers. The “Protein Progressives” are an adventurous group of consumers that understand the value of protein but are not afraid to try new things. During the pandemic, these consumers were largely unphased by the limited choices in meat cuts because they were comfortable learning to prepare new products. Although these consumers value protein, they are not tied exclusively to meat, and their experimentation with different protein options may draw them away from meat products.

The “Family First Food Lovers” are a family-oriented consumer group that makes mealtime about togetherness and feeling good. They are big meat eaters who want to know the story of their food. They appreciate a good “brand story” and will choose labels like “grass-fed” that indicate how their food was raised.

The “Aging Traditionalists,” as their name implies, skew towards an older population. These consumers were raised with meat at the center of their plate and are the least likely group to shift to plant-based proteins. These consumers understand that the nutritional value of meat is more than just protein and, while they understand label claims, their buying is not necessarily driven by these claims.

The remaining 10% of meat consumers fall into the category of “Wellness Divas.” These health- and wellness-oriented consumers are working to eliminate meat from their diets, and their purchasing choices are heavily influenced by label claims. In addition, although post-pandemic inflation has impacted most consumers to some extent, the Wellness Divas are more concerned about inflation than the other groups of consumers.

The results from Midan’s consumer segmentation studies are enlightening, but the industry should remember that there are other ways to view meat consumers. For example, as the U.S. population becomes more diverse, multicultural meat consumers will occupy an increasingly large share of the market. In multicultural households, grocery shopping responsibilities are often shared among multiple family members. These consumers often seek a variety of meats and meat cuts and have an awareness of and an interest in label claims.

Different generations also view meat choices differently. Millennials have made a strong shift towards making online purchases of meat, but they still want to know the story of their food. This generation consumes a large amount of protein of all types and is not afraid to experiment. Like the millennials, Gen Z consumers are generally adventurous eaters and are more likely to replace meat with plant proteins. The Gen Z consumer will often research food choices online, but unlike the millennials, this generation prefers to purchase meat in stores. Gen Z consumers are also the most impacted by short, attention-grabbing messaging that can be easily conveyed on smartphones. Overall, the Millennials, Gen Z, and beyond are the meat consumers of the future. These generations show us that the future meat consumer will continue to have an interest in the nutritional value of their food, the animal care practices used to raise meat, and the environmental impacts of their food choices.

The COVID-19 pandemic also had a dramatic effect on the meat market. Meat processing and food supply chains struggled early in the pandemic due to the virus’s effect on employee health as well as the abrupt end of in-person restaurant dining and corresponding shift to almost exclusive at-home cooking. The trend towards home-cooked meals has continued, with a large majority of meals still being cooked at home. Meat consumers have gained confidence in preparing meat themselves and have learned to cook more expensive meat products such as USDA prime or wagyu beef. As consumers seek a trusted meat source that can provide these higher-quality products, many consumers now purchase meat online.

The rapid inflation that followed the COVID-19 pandemic has also reshaped the market for meat products. Inflation associated with animal protein has been more volatile than overall inflation, so helping consumers see the value in animal protein will be key to ensuring meat consumers remain in the meat market. Although some consumers have reduced their meat purchases in response to inflation, overall demand is still high: many consumers are seeking out less expensive meat cuts,

freezing portions from multi-serving packaging, and purchasing more inexpensive grinds.

To stay relevant to consumers, the animal protein industry will need to continue sharing stories that reflect stability, value, and sustainability. Consumer purchases are impacted by USDA quality grades, but consumers are also looking to know more about how their food was raised. Antimicrobial use, hormone use, and animal care practices are all important considerations to today's consumer. By collaborating across the industry, animal protein producers can help tell their story of responsible antimicrobial use, proper animal care, and sustainable production. Consumers can then better understand where their food comes from and make informed choices based on genuine knowledge rather than label claims.

## **Antibiotics. One tool in the toolbox... what else are farmers, ranchers, and veterinarians using to care for animals?**

Antibiotics are an important tool for maintaining animal health, but they are by no means the only tool available. Optimal antimicrobial stewardship relies on effective utilization of all the tools in the animal health toolbox, including vaccines, nutrition, production stockmanship, and, when appropriate, antimicrobials.

Of the tools in the toolbox, stockmanship is often described as how to properly move cattle, but more importantly, it is a mechanism to reduce animal stress and thereby promote animal health. Animal health and stress are intimately intertwined due to the actions of the hormone cortisol. When stressed, the body releases cortisol into the blood stream. Cortisol prevents immune cells from leaving the blood stream for the site of infection or vaccine administration. In the case of infection, the absence of immune cells to fight the infection increases the risk of severe disease. In the case of vaccination, immune cells typically take up the vaccine antigen, transport it to lymph nodes, and present it to B-cells, which produce antibodies and develop the “memory response” critical to long-term protection. If an animal has high cortisol levels, the immune cells that first take up the vaccine antigen never arrive, effectively halting the immune process and greatly reducing the benefit of vaccination.

Stress can be induced by both physical and psychological stressors. Physical stressors include factors such as weather, pain, or malnutrition, while psychological stressors include disruption of social groups, unfamiliar environments, and threats from predators. An animal’s previous experiences greatly affect its susceptibility to stress, especially psychological stress, and good stockmanship from an early age can correspondingly reduce the impact of stressors and improve animal health.

Good people are the core of good stockmanship. Good people who know what they need to do, know how to do it properly, and know why they use the techniques they use to accomplish the task. With proper training, caregivers can learn to understand how predator-prey behavior and cattle vision impact cattle movement. Caregivers can then use their body position and posture, as well as movement angles and direction, to get cattle to move where they want them to with minimal stress. Moreover, caregivers learn to recognize *who* the front of the herd is rather than *where* the front is, and they can then identify the best animals to interact with

to move the entire herd. Building confidence through training helps a caregiver focus on the quality of their work rather than the quantity. A well-trained caregiver can help reduce animal stress, thereby reducing the risk of disease and the need for antimicrobials. Moreover, a well-trained caregiver who can recognize disease early and who knows the veterinarian-approved treatment protocols can reduce overall antimicrobial use and case fatality.

Although training good people is vital, good stockmanship is also about training the cattle. Every time people interact with cattle, the cattle are learning. When cattle/caregiver interactions are poor or negative, the cattle learn fear and stress. These cattle often display frantic or panicked behavior, which can be a danger to other cattle and the people around them. When cattle/caregiver interactions are positive, cattle become more confident and learn to trust people. These cattle may be calmer around people, or if they are truly confident, they may even exhibit playful or exuberant behavior.

Teaching cattle to be confident in their environment requires not only good stockmanship but also positive introductions to new environments and situations. For example, allowing young cattle to move through a chute system without being worked will reduce their stress levels the next time they enter the chute. The stress of weaning can be reduced by periodically keeping calves away from their dams overnight prior to weaning. These “slumber parties” help normalize the separation for calves, making weaning day much less stressful.

Transportation is another major stressor that cattle experience, often multiple times in their lifetime. Early training to acclimate cattle to people and new places, as well as calm loading, are helpful for ensuring a calm arrival. Whether this occurs or not, there are other opportunities to reduce stress after transportation. One way to help cattle acclimate more quickly is by “greeting” them, which introduces them to their source of guidance (the caregiver who is in the pen greeting them) and their destination (the direction in which the caregiver asks the cattle to move). After “greeting” the cattle, a caretaker can lead the cattle to their new pen, providing another opportunity to build the bond between cattle and handler. The pen itself can also play an important role in stress reduction. After a long trip, cattle, much like people, just want a comfortable place to rest. Providing bedding in the pen can promote the rest that they need and can speed their recovery from the stress of transportation. By reducing stress upon arrival at a new facility, the likelihood of disease declines, which can correspondingly reduce the need to use antimicrobials



for metaphylaxis. Overall, the producer has several tools available for maximizing animal health and wellbeing, farm productivity, and antimicrobial stewardship. Good stockmanship throughout life, combined with appropriate nutrition and adequate vaccination, can help ensure that antimicrobials are used only when necessary and that the animals themselves have a more pleasant life.

## **Antibiograms: Stepping into the Future of Veterinary Antibiotic Stewardship**

For several years already, the California Department of Food and Agriculture (CDFA) has had regulations requiring veterinary oversight for all medically important antibiotic drugs, putting them one step ahead of the national curve. To assist the veterinary community in implementing these regulations and improving antimicrobial stewardship, the CDFA has developed an Antimicrobial Use and Stewardship (AUS) program. This program collects data on the use and sales of medically important antibiotics, as well as data on resistance trends in animal pathogens and any animal management practices that impact health.

One of the most prominent projects of the CDFA's AUS program has been the development of antibiograms for various pathogens. Although antimicrobial susceptibility data can be helpful for guiding the treatment of individual animals, obtaining this data requires a number of laboratory steps, and the results are not always delivered in a timely enough manner to impact early treatment. To guide empiric treatment prior to receiving susceptibility results for a case, veterinarians can use antibiograms. An antibiogram is a collection of antimicrobial susceptibility data for a given pathogen across a specified time period in a specified animal population. In addition to guiding empiric therapy, antibiograms can also be used to assess susceptibility in an area and monitor trends in antimicrobial resistance.

Because antibiograms are relatively new to veterinary medicine, their impact on antimicrobial stewardship is not well documented (particularly in livestock), but they are becoming increasingly popular in human medicine. For example, antibiograms are now commonly incorporated into hospital stewardship programs. The Clinical Laboratory Standards Institute (CLSI) recommends that at least 30 isolates collected over a one-year period be used to build antibiograms. For cases where there were not enough isolates of a given pathogen in a given production group to meet the CLSI recommendations, the AUS program expanded the period of collection.

Through consultation with a panel of experts, the AUS program developed three different antibiogram formats. The most detailed format groups relevant antimicrobials by their mechanism of action and provides, for each antimicrobial, its CLSI breakpoints, a percent of isolates that fell into each of the minimum inhibitory concentration (MIC) values tested, and a percent of isolates categorized

as susceptible, intermediate, and resistant. Due to the lack of CLSI breakpoints for many veterinary pathogens, breakpoints from related pathogens are substituted when appropriate. The second format summarizes isolates by their classification as susceptible, intermediate, or resistant, but does not provide detailed MIC information. The succinct nature of these results allows multiple pathogens from the same disease process to be presented on a single page. The final format shows the percent susceptible for each antimicrobial using a graphic. Again, multiple pathogens from the same disease process are presented in one graphic.

The AUS program has developed antibiograms for at least one respiratory pathogen in cattle, small ruminants, and horses. In the near future, antibiograms will likely be added for pathogenic *Escherichia coli* in chickens, *Staphylococcus aureus* mastitis in goats, and salmonellosis in cattle. In addition to developing new antibiograms, the AUS program has been working to distribute antibiogram information, provide continuing education, and build a digital user guide to help veterinarians use this tool in their practice. Finally, the AUS would like to further improve the utility of antibiograms by building regional or farm-specific antibiograms and broadening the number of veterinary pathogens with CLSI breakpoints.

**Resource:**

- [CDFA AUS Website](#)

## **New veterinary medicine: OTC to RX**

In June 2023, FDA's Guidance for the Industry #263 will take effect, shifting all remaining over-the-counter (OTC) medically important antimicrobials to prescription labeling<sup>10</sup>. Retail operations in Tennessee and Kentucky are concerned that the typical producer in their region—a part-time farmer with less than 25 head of cattle—is not only unprepared for these changes but also knows nothing about them. The major concern is that these producers will not find out about the changes until the antimicrobials they need are no longer on the store shelves when they need them, which would leave ill cattle untreated and possibly increase cattle deaths.

These changes in drug labeling will also impact retailers. Following the shift of in-feed antimicrobials to veterinary feed directive status, retailers saw a decline in the sales of medicated feeds, a trend that is consistent with FDA data on veterinary antimicrobial sales<sup>13</sup>. Retailers are accordingly concerned that the upcoming label changes will further impact their sales of antimicrobials and of other products that may be purchased by customers who come to the store for antimicrobials.

Aggressive retailers, particularly those with pharmacists on staff, have already started planning for the upcoming changes by adding veterinarians to their staff or building relationships with local veterinary clinics. These retailers are also actively engaged in educating employees and customers about the upcoming changes. However, typical retailers are likely doing much less to anticipate this change, which could leave both retailers and their customers unprepared.

To smooth the transition from OTC to prescription antimicrobials, clear and effective communication will be key. The Cooperative Extension System is one important messenger, but the retailer is too. The true impact of these changes on producers, retailers, veterinarians, and manufacturers will, of course, not be known until after the new guidance is implemented, but education will assuredly be vital to keep all businesses moving forward.

## Global Perspective on Antimicrobial Resistance and Use Policies

Agriculture across the world is facing pressure to feed more people with fewer farmers, fewer acres in production, and fewer inputs. Achieving this goal will require sustainable, science-based legislation that can adapt to changing future conditions, which could otherwise put food security at risk. Global trade policy is one such area that cannot be overlooked. Trade policy changes rapidly, often much faster than the scientific community can respond to ensure that policy decisions maintain a commitment to science. Global policies can also impact how food is produced domestically, either by providing an impetus for new domestic policy (often at the state level) or by impacting export markets.

One trade policy that has come under great scrutiny in the animal agriculture industry is Article 118 of the European Union (EU), which regulates veterinary medicine. Though Article 118 was to go into effect in 2023, the controversy surrounding it will likely delay implementation. This article would specifically impose EU antimicrobial use rules on all countries exporting to the EU. In doing so, it would alter a number of commitments under the World Trade Organization (WTO) and impact animal production practices worldwide. Problematically, Article 118 creates the perception that one region of the world can dictate agricultural practices worldwide, even though doing so ignores the fact that different regions face different risks and challenges that may necessitate different practices.

Given the speed at which global trade policy can change and the impact those changes could have on business and domestic practices, it is critical to remain informed of international policies and practices. This awareness can help the scientific community be prepared to respond rapidly to any changes and ensure that science-based rules are being developed.

Awareness of the global stage can also help governments and industries prepare for potential domestic policy. Domestic agricultural organizations that work internationally, including the USDA Foreign Agricultural Service, U.S. Trade Representative, FDA, and USDA-APHIS, can provide valuable insights into foreign policy. Trade organizations can have important insights as well. On a broader scale, global regulatory bodies are a vital information source. As trade policy shifts to cover not only what is traded but also how it is produced, the WTO is becoming increasingly prominent on the world stage. The World Organization for Animal

Health (WOAH, formerly the OIE) provides guidance on all aspects of animal health, including antimicrobial use. WOAH is currently updating its chapter on antimicrobial resistance to include both livestock and companion animals. The plant side of agriculture is largely represented by the UN's Food and Agriculture Organization (FAO). Finally, the World Health Organization rounds out the human side of the One Health triad. Together, these international organizations have great influence over animal health, food security, and human health. The manufacturers of animal health products already recognize the importance of global policy and monitor it closely. The rest of animal agriculture would benefit from doing the same.

## **Stewardship – Research to Practice**

A recent policy of the American Veterinary Medical Association (AVMA) supports increased collection of antimicrobial use data to better understand the opportunities and challenges in improving antimicrobial stewardship<sup>14</sup>. Although understanding antimicrobial use is important for guiding stewardship decisions, use data can remain challenging to collect. First, there is no effective, universal system for tracking antimicrobial use. Recordkeeping practices vary from farm to farm, and some farms lack a means to record antimicrobial use or use inconsistent disease terminology. Second, there is no consistent standard for how to record use, and the relative usefulness of the available metrics is still unclear.

Nevertheless, antimicrobial use data can help improve both antimicrobial stewardship and the overall sustainability of animal agriculture. In the dairy industry, the Food Armor program has been using use data to elicit positive change on dairy farms for several years already. Through improvements in recordkeeping and monitoring of antimicrobial use, Food Armor has helped producers improve productivity and reduce costs while maintaining good antimicrobial stewardship. Programs like Food Armor demonstrate the power of antimicrobial use data to benefit producers and promote responsible antimicrobial use. With improved funding to bring new resources for data collection, antimicrobial use data may have an even greater impact.

## Exploring the Potential for a Public-Private Partnership to Support the Tracking and Monitoring of Antimicrobial Use in Food-Producing Animals

Sales and distribution data for antimicrobial products used in food-producing animals have been available yearly for over 10 years, but these data do not necessarily reflect antimicrobial use. In addition to potential disparities between what antimicrobials were sold and what were used, these data do not provide information on the species a product was used in or the indication a product was used for. Because of these shortcomings, sales data cannot effectively guide antimicrobial stewardship. Instead, the industry requires a system that can collect livestock antimicrobial use data directly, rather than through a proxy like sales. Such a system would improve transparency regarding antimicrobial use. Moreover, such a system could improve monitoring for trends in antimicrobial resistance and its drivers, help build stewardship practices, and inform regulatory and policy decisions.

In 2015, the Food and Drug Administration (FDA) held public meetings to explore options for tracking antimicrobial use. These meetings were followed by cooperative agreements to develop methods of tracking. The results from these cooperative agreements were summarized in a special issue of *Zoonoses and Public Health* in 2020. In 2022, the FDA tasked the Regan-Udall Foundation, an independent non-profit organization partially supported by the FDA, with exploring how a public-private partnership could support voluntary antimicrobial use tracking in livestock.

The Regan-Udall Foundation first engaged stakeholders from every part of the livestock and animal health industries to identify key objectives and principles that would need to be addressed. These discussions revealed that collecting standardized data on livestock antimicrobial use would be challenged by the need to collect and record multiple characteristics about the context of each use. For example, for every antimicrobial administered, use data should include the species treated, indication, as well as the body size and number of animals. This information is not always available. Data collection is further complicated by differing production practices and industry structures, as well as the different needs of each commodity group. Overall, an environment of mutual trust will be



essential for ensuring access to useable data while maintaining the privacy of those providing the data.

Following their publication of a summary report on these discussions, the Regan-Udall Foundation has moved on to the next steps in their project. The organization is currently addressing issues in data management and working with stakeholders to determine potential governance and financing models that are comfortable for everyone and would support voluntary participation. Although the final structure of the antimicrobial use tracking system is not yet known, the FDA and Regan-Udall foundation believe that a public-private partnership rooted in collaboration, cooperation, and careful planning could provide an opportunity to better understand antimicrobial use in livestock and how these data can improve antimicrobial stewardship.

Resources:

- [Zoonoses and Public Health: Antimicrobial Use Data Collection and Reporting](#)
- [Regan-Udall Foundation Summary Report on Antimicrobial Use Data](#)
- [AVMA Policy on AMU data and Antimicrobial Stewardship](#)

## **Breakout Sessions**

### **Communication**

Antimicrobial stewardship in animal agriculture is a complex topic: despite the abundance of scientific information and research findings supporting industry practices, these pieces of data are unlikely to build connections between the industry and consumers. To emphasize the importance of consumer engagement, the communication breakout session kicked off with the motto to “defend the industry, not your dissertation.”

Understanding the meat consumer is a critical first step in answering the consumer’s main question: “what’s in it for me?” The National Pork Board presented a variety of survey data about the typical meat consumer and noted that consumers care about industry transparency, animal care, their families, the lives of livestock industry workers, and the health of the planet. To create messaging that resonates with meat consumers, producers need to recognize consumer concerns and convey a positive story that is rooted in the values of the industry. Even as this messaging is being developed and disseminated, consumers are hearing other messages from other sources, and it is therefore important to know what other information is out there.

Although careful preparation will help the industry develop strong messaging, the way that message is presented will be critical. To make the stories of animal agriculture truly resonate with consumers, presenters should be confident and credible and have a plan to maintain control of their message. Even with the best communication, relationships between producers and consumers take time. By making a commitment to understand their audience, share stories that reflect the values of the industry, recognize opposing messaging, and maintain control of their storyline, animal agriculture can continue to build a positive relationship with consumers and guide how consumers think and feel about the industry.

### **Research**

The research breakout sessions, led by the National Institute of Antimicrobial Resistance Research and Education (NIAMRRE), began with an opportunity for participants to think more deeply about challenges and research gaps in antimicrobial stewardship. Participants were asked to choose two photos from a collection of several hundred: one photo representing their vision of the future of antimicrobial stewardship or resistance, and one photo representing challenges the

industry will face to get there. This type of activity, while simple and fun, can help reveal participants' deeper thoughts on antimicrobial stewardship and current challenges. Small groups then chose a potential area of change that might occur in the industry and identified the first-, second-, and third-order implications of this change. This process, known as implication thinking, can help improve foresight and identify any research gaps that may arise should these changes be implemented.

The second research breakout was a discussion focused on a recent cooperative agreement between NIAMRRE and the FDA. In this agreement, the agencies aim to prioritize livestock diseases for the future development of antimicrobial alternatives. Participants in the breakout session discussed lists of the diseases associated with antimicrobial use in the beef, dairy, broiler, and swine industries, organized by production stage. Although the participants identified only a few gaps or omissions, there were several suggestions to refine the list, such as splitting coliform mastitis into *Escherichia coli* and *Klebsiella* because the different pathogens may be treated differently.

The more in-depth discussion in the second breakout revolved around how to prioritize the diseases on NIAMRRE's list to identify the best targets for antimicrobial alternatives that could reduce reliance on antimicrobials for the management of these diseases. From a public health perspective, the use of medically important antimicrobials and the route of antimicrobial administration are certainly important factors for determining which diseases to focus on, but other farm-related factors are also vital to driving the development of alternative therapies. For example, diseases with a high prevalence may be the best candidates for alternative practices or products for prevention or treatment because there would be a larger potential market for these alternatives. Similarly, the likelihood of adopting new type of therapy will be higher for diseases with a high fatality rate or a larger economic impact. While these criteria are important in ranking these diseases, participants noted that the process is further complicated by the difficulty in measuring antimicrobial use in a meaningful way.

This series of breakout sessions was attended by a variety of participants representing academia, government, private practitioners, producers, the animal health industry, packers and processors, and retailers. As a whole, the research breakout sessions provided an opportunity to identify future research needs and

discuss how to best direct that research so that it will have the greatest benefit to both human and animal health.

## **Education**

The education session provided an opportunity for participants to interact, brainstorm, and discuss how science education can be taught through the lens of animal agriculture. In partnership with the NIAA, the American Farm Bureau Foundation for Agriculture (AFBFA) has developed a teacher fellowship program built on the One Health concept. This program, borne out of discussions at the 2021 NIAA Antibiotics Symposium, seeks to provide teachers with professional education that incorporates real-life experiences that build a positive view of animal agriculture. Part of the education breakout session focused on how this program could be further developed and refined to maximize its impact.

First, participants in the education breakout session identified potential issues and common misconceptions in the industry, then developed ways to restate these issues to facilitate exploration. Some of the thought-provoking questions that arose from the discussion included “How might we engage educators in antimicrobial resistance research?” and “How might we engage educators in understanding food labeling practices?”

The second education breakout session focused on what the real-life experiences in the AFBFA fellowship could look like. For example, teachers could get engaged in agriculture-related research through running on-site tests or working with veterinarians. These experiences could then build towards training teachers to analyze industry data and thereby improve their ability to differentiate valid from invalid research results or articles.

Overall, the science that can be conveyed through the One Health framework and the animal agriculture lens touches on a wide range of topics that educators need to be familiar with. Through partnerships between teachers and organizations like AFBFA and NIAA, the ideas from these breakout sessions can help strengthen educator confidence and improve student learning. Encouragingly, AFBFA will use the outcomes of these breakout sessions to determine the next tactical steps in the development of their teacher fellowship program.

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