

A Balanced Approach to Understanding the Science of Antibiotics in Animal Agriculture



IN 2012, THE ACADEMY OF Nutrition and Dietetics Foundation (Academy Foundation) launched the Future of Food initiative in collaboration with Feeding America and the National Dairy Council, with an educational grant from the National Dairy Council. Early aims of this initiative were to work with nutrition and hunger relief professionals to increase awareness of food insecurity as a public health issue; promote access to healthy, nutritious food for all Americans; and increase quality nutrition education, targeting those dealing with food insecurity. In 2013, The Future of Food initiative expanded to also address global food security and consumers' increasing interest in food production. Extensive opportunities exist for registered dietitian nutritionists (RDNs) and Academy of Nutrition and Dietetics (Academy) members who work in food systems to promote optimal health for the growing world population,¹ and RDNs must be able to relay science-based information to consumers about agriculture and food production technologies, safety, nutrition quality, and health implications.

Of particular interest to consumers² and RDNs is the use of antibiotics in agriculture. An unpublished member survey³ in 2014 (n=361 respondents) found that nearly half of Academy member respondents believed US farming and food production practices

needed improvement. The use of antibiotics and hormones were among the top concerns of members who held negative views of US farming practices. Furthermore, 87% of member respondents indicated that they were interested in learning more about the use of antibiotics and growth hormones administered in livestock raised for human consumption.

In response to this interest, the Academy Foundation hosted a symposium at the Academy of Nutrition and Dietetics 2015 Food & Nutrition Conference & Expo in Nashville, TN. The symposium was called "A Balanced Approach to Understanding the Science of Antibiotics in Animal Agriculture." The purpose of this symposium was to present the science supporting differing viewpoints on the use of antibiotics in animal agriculture. The symposium panel included two veterinarians and an RDN who is also a farmer. Gail Hansen, DVM, MPH, is a licensed veterinarian with a master's degree in epidemiology, who currently works as a consultant on public health policy and infectious disease. Mike Apley, DVM, PhD, is a licensed veterinarian with a doctorate in veterinarian clinical pharmacology and currently works as a professor at Kansas State University. Dee Sandquist, RDN, is a practicing registered dietitian nutritionist, and she and her husband operate a farm where they raise cows, hogs, and a variety of crops. Panelists were asked five questions, and they were each allowed time to respond with prepared presentation slides. This article provides an overview of the use of antibiotics in agriculture, using information drawn from the panelist presentations.

ANTIBIOTICS IN THE FOOD SUPPLY

Antibiotics, also known as antimicrobial drugs, have been used in food animals as well as by humans for over half a century.⁴ Use of antibiotics has

had positive effects; antibiotics have saved the lives of millions of people since they were first discovered in 1928.⁵ Antibiotics given to food animals have potentially protected public health and food safety by lowering the transmission rates of zoonotic and foodborne pathogens from animals to humans, such as *Clostridium perfringens*, *Campylobacter*, *Escherichia coli* O157:H7, and others.⁶ Antibiotics also have been recognized as a way to promote sustainable livestock production.⁷ Other benefits for livestock noted as early as 1950 include growth promotion and weight gain.⁸ Antibiotic use in food animals is approved by the United States Food and Drug Administration (FDA) Center for Veterinary Medicine for the following purposes⁹:

- *disease treatment* for animals that are sick;
- *disease control* for a group of animals when some of the animals are sick;
- *disease prevention* for a group of healthy animals that are at risk of becoming sick; and
- *growth promotion* or *increased feed efficiency* in a herd or flock of animals to promote weight gain.

Overuse and misuse of antibiotics, whether in humans or in animals, can lead to antibiotic-resistant bacteria and has become a major global public health concern.^{4,9-11} Between the years 2009 and 2013, use of antibiotics in food-producing animals increased by 17%.¹² In April 2012, the FDA released a report, "The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals." The report provides a framework for the voluntary adoption of drug sponsor practices aimed at ensuring the judicious use of antimicrobials in food animals.^{4,13} These practices include a commitment to voluntarily remove any growth uses from product labels of medically important antibiotics by December

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2016, and that once the label has been changed, it will be illegal for producers and veterinarians to use these drugs for growth promotion.¹³

RESISTANCE AND RESIDUE

Antimicrobial resistance is considered one of the major threats to public health.⁹⁻¹¹ Resistance occurs when microorganisms (such as bacteria) change in ways that make antibiotics ineffective for treatment.¹⁴ Development of resistance is a normal evolutionary process for microorganisms, but resistance has rapidly accelerated and has been amplified by both appropriate and inappropriate widespread use of antibiotics.^{5,10,14} Inappropriate use of antimicrobial drugs enables rapid proliferation of antimicrobial-resistant bacteria, increasing the opportunity for the development of drug-resistant infections in humans and animals.⁴ To compound the problem, some drug-resistant bacteria share resistance with bacteria that were previously responsive to antimicrobial drugs.¹¹ This means that medically important antibiotics used to treat routine infections such as urinary tract infections, pneumonia, and skin wounds are becoming less effective, making treatment more costly and with poor outcomes.¹¹ According to the Centers for Disease Control and Prevention (CDC), “simply using antibiotics creates resistance.”¹¹ A reported 70% of bacterial infections are resistant to at least one drug, raising concerns that antibiotics may one day be ineffective for more complicated medical and surgical procedures such as organ transplants and joint replacements.¹¹ The CDC reports that more than 2 million people are annually sickened with antibiotic-resistant infections, resulting in at least 23,000 deaths.¹¹ Estimated health care systems costs vary, but the World Health Organization reports that the medical costs of antibiotic resistance in the United States are \$21 to \$34 billion annually.¹⁰

Multiple sources contribute to antibiotic resistance, including humans, farm animals, pets, environment, produce, and animal feed. Apley and Hansen agreed that the contribution of animals compared with humans in antibiotic resistance is unknown, and determining the exact fraction attributable to food animals is challenging. However, concerns over antibiotic misuse are not

limited to animals. In 2015, the White House released a national report on combating antibiotic resistance, with recommendations that patients receive “the right antibiotic at the right time at the right dose for the right duration.”⁵ The CDC encourages antibiotic stewardship in health care through its Get Smart for Healthcare program¹⁵ and discourages use of antibiotics for anything other than bacterial infection.⁵

Consumers have raised concerns about eating foods contaminated with residues from antibiotics.¹⁶ Apley and Hansen agreed that antibiotic residues on meats are rare and do not contribute significantly to antibiotic resistance. However, foods contaminated with antibiotic-resistant bacteria may contribute to antibiotic resistance.¹¹ This occurs when animals treated with antibiotics develop resistant bacteria in their gut that is transferred to meat.¹¹ Fecal shedding, and the resultant fertilization of crops with manure that contains antibiotics¹⁷ or resistant bacteria,¹¹ is also a mechanism for the spread of antibiotic-resistant bacteria. Consuming foods that contain antibiotic-resistant bacteria can cause antibiotic-resistant bacteria to remain in the human gut, thus contributing to the spread of antibiotic resistance.¹¹ The study of antibiotics in the environment is still relatively new, as is the concept that both humans and animals contribute to environmental accumulation of antibiotics.¹⁷ The CDC encourages safe food-handling practices to minimize consumption of antibiotic-resistant bacteria in food.¹¹

REGULATION OF ANTIBIOTIC USE

Antibiotic use in food animals in the United States is regulated by the federal government, and the food industry has programs and guidelines on appropriate use. The Academy's Food and Water position paper supports robust collaboration between government and industry to create effective food safety efforts.¹⁸

Government Regulation

Both the US Department of Agriculture and the FDA have programs in place for monitoring antibiotic residue and enforcing regulations.¹⁶ The FDA ranks antibiotics according to their relative

importance in human health and medicine.¹⁹ Currently, approximately 98% of the medically important antibiotics used in animals are easily available over the counter for treatment in animal feed and water.¹² The FDA recognizes the concerns related to use of medically important antibiotics and, as previously mentioned, has recently issued guidance on voluntary steps to be adopted by animal drug producers by December 2016.^{4,13} The guidance defines *judicious use* as avoidance of unnecessary or inappropriate use, and it requires a full implementation plan for two major, mandatory guiding principles set to go into effect in 2017.⁴

The first principle is that the use of medically important antimicrobial drugs is limited to uses considered necessary for assuring animal health. In other words, use of medically important antibiotics strictly for the use of growth promotion will no longer be available and will not be allowed once the drug labels are changed. The second principle is that the administration of medically important antibiotics come under veterinary oversight and control.^{4,13} This means that, eventually, medically important antibiotics administered in feed and water will no longer be available over the counter and will be restricted in use for disease treatment, prevention, and control. Apley stated that farmers and producers will need to strengthen their veterinary client–patient relationship as a result of these new FDA guidelines. Although these new regulations are thought to contribute to greater transparency and more judicious use of antibiotics in food animals, Hansen mentioned concern with the federal government and industry establishing comprehensive on-farm monitoring, accountability, and oversight for antibiotic use in animal agriculture, and whether such activities will influence the cost of meat.

Industry Regulation and Programs

Food animal industries recognize public health concerns related to the use of antibiotics, as well as consumer demand for safe food. Apley pointed out that all animal agriculture industries have a stake in ensuring compliance with government regulations, and emphasized the fact that sick animals

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