Antibiotics in Animal Agriculture: What You Need to Know

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Five papers published in *Annals of the New York Academy of Sciences*[1] examine the use of antibiotics in animal food production and a holistic approach to the impact of antimicrobial resistance on human, animal and environmental health.

"If you think you understand antimicrobial resistance, it hasn't been explained properly to you."[2]

SUMMARY

Antimicrobial resistance (AMR) is emerging as the prototypical One Health issue of our time. Bacterial resistance to antibiotics used in animal food production continues to emerge, propagate, and persist across the full spectrum of human (both community- and hospital-based) and animal health (including food animals, companion animals, and aquaculture) in a variety of environmental settings.

The science of AMR is complex because of its interconnected, multilayered and multifaceted features. As important as antibiotics are, the consequences of overuse that lead to resistance can be life threatening. Meanwhile, effective and readily adoptable solutions to the problem remain elusive.

Individual and societal decisions that must be taken concerning the appropriateness of various uses of antimicrobial products come with conflicting moral and ethical imperatives concerning human, animal and environmental health.

To grasp this complex situation, a holistic approach that considers the broad range of stakeholders involved is necessary. The One Health approach helps to achieve a more complete understanding of the AMR problem, enable efficient solutions, develop appropriate usage guidelines, and provide effective risk communications.

In a special issue of *Annals of the New York Academy of Sciences*, four papers and a summarizing commentary consider some of the complexities associated with AMR:

1. Considerations of the criticality of different classes of antimicrobials used for human and animal health and how guidelines and regulations might result in more prudent use.
2. The recognized importance of the environment (i.e., soil, water, air) as a reservoir of resistant bacteria and resistance genes, as well as a pathway for the dissemination of AMR between human and animal host populations.
3. Established and novel solutions for measuring and containing the AMR problem that range from animal husbandry and herd management changes, to technological innovations such as bacteriophage therapy.
4. Effective strategies for communicating to consumer about the risks of antimicrobial resistance spreading from food production.

COMPETING LISTS OF CRITICALITY AND THEIR IMPACTS ON USE

- Initially, antimicrobials are effective against targeted bacterial pathogens, but the longer a drug has been used, the higher the levels of resistance across the spectra of drug–bacteria combinations.

- As effective antimicrobials become scarce––and there are fewer to replace them––a pressing need arises to prioritize those that remain effective as "top shelf" drugs. As a result, various international, national and other agencies have developed competing lists of importance for antimicrobials for human and animal health.

- A complete restriction of use of all classes of medically important antimicrobials in food-producing animals, for prevention of infectious diseases that have not yet been clinically diagnosed, has caused some confusion. This comes from the lack of a universally accepted definition of prevention across the various stakeholder organizations.

DISSEMINATION OF RESISTANCE ACROSS DOMESTICATED ANIMAL, HUMAN AND ENVIRONMENTAL SYSTEMS

- Over the past decade, there has been a modest renaissance of scientific interest and funding opportunities for exploring the role of the environment in the ecology of AMR. Over the past 50 years, periodic focus has been directed toward the environment, but has rarely been sustained. Typically, the focus has been on the hospital ward or the farm.

- It is now known that domesticated animals, humans, and environmental systems are potential sources and sinks for antimicrobial resistance and that the dissemination of this resistance occurs at a global scale, for example, through the trade of animal food products, international travel, and wildlife migration.

MANAGEMENT OF RESISTANCE IN ANIMAL AGRICULTURE

- For as long as bacterial resistance to antimicrobials has existed, solutions to the expanding problem of antimicrobial resistance have been developed in both human and animal health, but none alone have been able to avoid the natural process of pathogenic resistance.

- Practical solutions to the problem of antimicrobial resistance must either address the need for treatment, control, or prevention of bacterial infectious diseases of livestock, companion animals, and humans, or provide viable alternatives to the antibiotics.

- Reducing the use of antibiotics in food animals will require a multifaceted approach that includes the expansion of established practices within flock and herd management (e.g. environmental and nutritional optimization, sanitation and disease surveillance) and the development and utilization of emerging approaches, such as new and more effective vaccines and potential phage-based therapies.

COMMUNICATING RISKS CONCERNING AMR IN THE FOOD CHAIN

- The universal problem of understanding and communicating AMR extends from the scientific community through to health professionals, food animal producers, patients, and consumers.

- Despite knowledge gaps, there exists a very real need to effectively communicate what is understood regarding the risks associated with antimicrobial use and resistance, especially in relation to the safety of the food supply chain.

- The authors of the paper also explore plausible alternatives to such "never, ever" policies, relying instead on process-verified programs that blend animal welfare, environmental, and antimicrobial stewardship principles.

- Sustainable environmental practices, and transparency regarding antimicrobial uses at an enterprise level, offers the greatest opportunity for useful, open, and honest communications with consumers.

NOTES:

1. The full text of all papers in the special issue Antimicrobial Resistance in a One Health Context: Exploring Complexities, Seeking Solutions and Communicating Risks. *Ann NY Acad Sci* 1441 (2019), may be downloaded from nyaspubs.onlinelibrary.wiley.com/toc/17496632/2019/1441/1

2. Guy H. Loneragan, veterinary epidemiologist and Professor of Food Safety and Public Health, Texas Tech University. Likely adapted from Richard Feynman's famous quote: *"If you think you understand quantum mechanics, you don't understand quantum mechanics".*

3. A virus that parasitizes a bacterium by infecting it and reproducing inside it.

Additional resources include:

- nyas.org/ebriefings/2019/antimicrobial-resistance-in-food-animal-production/
- nyas.org/ebriefings/antibiotics-in-food-can-less-do-more/