Solutions Through Science: Finding and Fighting Antimicrobial Resistance in Animals and the Environment

A Global Threat: Our Medicines Are Becoming Less Effective

Antimicrobials are substances, such as antibiotics, that kill microorganisms or prevent them from growing and causing disease. For example, antibiotics are a type of antimicrobial that fight bacterial infections in humans and animals. Antimicrobial resistance (AMR) is a global health threat because it makes antimicrobials less effective. Addressing AMR is a high priority for the agricultural and public health sectors because antimicrobials are among our most critical tools for treating serious infections in people and animals.

What Is AMR?

AMR occurs naturally when microbes evolve to survive the drugs designed to eliminate them. Many things, including medical and veterinary treatments and disposal of human and animal waste, can affect the number and kinds of resistant

bacteria in people, animals, and the environment.

APHIS' Role: Teaching Responsible Use

With its extensive animal health expertise and strong Federal, State, and industry partnerships, APHIS plays a critical role in identifying AMR in diseases found in livestock and poultry, as well as domestic cats and dogs. To minimize AMR, APHIS promotes responsible use of antimicrobial products in animals.

Studying On-Farm Practices and Resistance

APHIS' National Animal Health Monitoring System (NAHMS) collects survey information provided by U.S. farmers and ranchers. The goal of collecting this information is to better understand how antimicrobials are used in animal agriculture. NAHMS looks at representative percentages of operations that use antimicrobial drugs, the reasons for their use, and the percentage of animals treated. NAHMS studies also capture data about on-farm antimicrobial stewardship practices, including recordkeeping, employee training, and the use of veterinarians.

These studies also document tools other than antimicrobials that are used to control difficult problems, such as liver abscesses in feedlot cattle. The studies give insights into vaccination and other disease prevention strategies that can decrease the need for antimicrobials. Recent studies include Health Management on U.S. Feedlots 2021 and Swine 2021.

NAHMS is working with veterinarians, USDA's Agricultural Research Service, and several universities on projects to better understand AMR in animals. Some of the projects focus on improving sampling for AMR in swine and feedlot cattle to promote better tracking of resistance patterns and antimicrobial use. The projects will also examine trends in antimicrobial use and AMR on farms where chickens are raised for meat.

Other projects provide lab testing for goat, swine, and bison fecal samples, which helps identify AMR in bacteria from these animals and improve our understanding of the factors associated with AMR. For more information about NAHMS, visit National Animal Health Monitoring System.

Monitoring for AMR and Evaluating Genetic Components

Veterinary clinics and diagnostic laboratories across the United States submit samples to the National Animal Health Laboratory Network (NAHLN) to look for AMR in pathogens routinely found in cattle, swine, horses, and poultry, as well as domestic dogs and cats.

NAHLN updates the information in near real-time via a dashboard at the NAHLN AMR Pilot Project. Through NAHLN's centralized data collection and reporting, APHIS monitors trends and identifies new or emerging resistance to current antimicrobials, helps assess the continued usefulness of antimicrobials over time, and provides guidance to veterinarians, producers, and other stakeholders. Scientists use the information in a number of Federal, State, and academic collaborations, including several that evaluate genetic components of AMR pathogens that cause diseases such as diarrhea, pneumonia, and skin infections in our animal populations.

APHIS' National Veterinary Services Laboratories (NVSL) tests and diagnoses antimicrobial susceptibility and is conducting several research studies related to AMR genetics. One project, which analyzes Salmonella serotypes (a distinguishable strain of a microorganism) for AMR genes, will provide baseline, comparison data for outbreak investigations and future studies. NVSL is also studying reptile samples for the presence of multidrug-resistant Salmonella, which scientists can then compare to Centers for Disease Control and Prevention data.

Wildlife's Part in AMR Transmission

Outbreak investigations show a pattern that wildlife can introduce diseases to livestock and poultry. Understanding the role wildlife plays in spreading AMR bacteria in the environment can help scientists identify risks to livestock and crops, as well as preventive measures that could help protect agricultural operations.

Scientists at APHIS' National Wildlife Research Center (NWRC) are developing AMR bacteria diagnostics for wildlife. They are also conducting research on several species to determine their potential for transmitting disease to livestock and crops.

NWRC identified multiple wildlife species, such as raccoons, gulls, and European starlings, as hosts that can move AMR bacteria across wide areas and—in some cases—continents.

NWRC also found that feral swine samples collected at landfills show resistance to multiple antimicrobials. The samples also contained bacteria that were highly

resistant to antimicrobials like carbapenems that are considered antimicrobials “of last resort” for complicated bacterial infections in people. The samples were also resistant to fluoroquinolones, commonly used to treat many human and animal illnesses. To learn more, visit:

- Wildlife-Borne Pathogens Affecting Food Safety and Security
- Detection of Colistin-Resistant *E. coli* in Feral Swine
- Gulls as Source of Environmental Contamination by Colistin-Resistant Bacteria
- Continental-Scale Dispersal of Antimicrobial Resistant Bacteria by Gulls
- Role of European Starlings in Disseminating Multidrug-Resistant *E. coli*

Education and Outreach

APHIS’ National Veterinary Accreditation Program includes trainings on the Use of Antibiotics in Animals, the Veterinary Feed Directive, and the Role of Veterinarians in Honey Bee Health. For more information about NVAP, visit National Veterinary Accreditation Program.

APHIS also educates dog breeders regulated under the Animal Welfare Act about the risks of AMR and the importance of antimicrobial stewardship.

Future Directions

In addition to the activities outlined here, APHIS scientists are involved with national and international efforts to understand and combat AMR through collaborations with other agencies, nonprofit organizations, and universities.

While the U.S. Food and Drug Administration regulates antimicrobial use in animals, AMR demands a One Health, collaborative response from all of us. APHIS is committed to growing our knowledge and pushing the science forward to inform smarter policy solutions and protect valuable antimicrobial tools in the future.

For more information on AMR and the threat of AMR to human and agricultural health, visit:

- USDA Antimicrobial Resistance Action Plan
- National Action Plan for Combating Antibiotic-Resistant Bacteria 2020–2025
- Antibiotic Resistance Threats in the United States, 2019
- Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria (PACCARB)

Meet Your APHIS Scientists

Many APHIS scientists are working on emerging genetic technologies. Here are just a few:

Dr. Chelsey Shivley
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Ecology of AMR in Wildlife

Dr. Jeffrey Chandler
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Microbiology of AMR in Wildlife

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APHIS protects the health of U.S. agriculture and natural resources against invasive pests and diseases, regulates genetically engineered crops, administers the Animal Welfare Act, and helps people and wildlife coexist. We also certify the health of U.S. agricultural exports and resolve phytosanitary and sanitary issues to open, expand,

and maintain markets for U.S plant and animal products.

USDA touches the lives of all Americans each day in so many positive ways. In the Biden-Harris Administration, USDA is transforming America’s food system with a greater focus on more resilient local and regional food production, fairer markets for all producers, ensuring access to safe, healthy and nutritious food in all communities, building new markets and streams of income for farmers and producers using climate smart food and forestry practices, making historic investments in infrastructure and clean energy capabilities in rural America, and committing to equity across the Department by removing systemic barriers and building a workforce more representative of America. To learn more, visit www.usda.gov.