

Antibiotic Resistance in Food Systems: What Livestock Producers Need to Know

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Antibiotic resistance is a growing public health concern that affects food production, and human and animal health. It develops when bacteria change over time in ways that make antibiotics less potent or no longer effective against them. As a result, infections can become harder to treat, last longer, and in some cases lead to severe illness or death. The issue is particularly important in food systems because certain bacteria associated with animals, food, water, and the farm environment can develop resistance and move through the food chain. A helpful way to understand this issue is through the One Health concept. One Health recognizes that the health of people, animals, plants, food systems, and the environment are closely connected. In the case of antibiotic resistance, bacteria and resistance traits can move among humans, animals, food, water, manure, soil, and the environment. Therefore, due to these problems and concerns, reducing the risk of development and spread of antibiotic-resistant bacteria requires informed decisions, responsible practices, and coordinated actions across the food systems. This publication explains the cause of antibiotic resistance, how antibiotic-resistant bacteria can spread through food systems, and practical steps across the food systems that can help reduce the development and spread of antibiotic-resistant bacteria. In the United States, medically important antibiotics are no longer approved for growth-promotion purposes in food-producing animals. When medically important antibiotics are administered through feed, their use requires a Veterinary Feed Directive (VFD) issued by a licensed veterinarian. When administered through drinking water or other approved routes, their use requires veterinary prescription or oversight. These antibiotics may only be used for therapeutic purposes, such as the treatment, control, or prevention of disease. Therefore, this publication focuses on prudent therapeutic use rather than growth-promotion use.

What is Antibiotic Resistance?

Antibiotics are medicines that help fight infections or illnesses caused by bacteria. Antibiotics do not treat viral infections such as cold or flu. Antibiotic resistance happens when bacteria survive exposure to antibiotics that once would have controlled or killed them. This does not mean the animal or person becomes resistant. It implies that bacteria become harder to control or kill through standard treatment practices. That

distinction is important because many people have misunderstood antibiotic resistance. WHO (World Health Organization) describes antimicrobial resistance broadly across different microbes and medicines, while food-systems publications often focus specifically on antibiotic resistance in bacteria of human and animal health importance. Producers should be informed that bacteria develop resistance, survive, and multiply when they are not well targeted. This is why responsible use matters. Antibiotics remain important tools for treating sick animals, but they should be used carefully and appropriately under veterinary guidance. WHO and FAO (Food and Agriculture Organization) both emphasize reducing unnecessary use of antibiotics while protecting animal health and food production.

How do Bacteria Become Resistant to Antibiotics?

Resistance can develop in several ways. Sometimes bacteria naturally acquire changes in their genetic material (as part of a survival mechanism) that help them survive antibiotic exposure. In other cases, bacteria can receive resistance genes from other resistant bacteria. This can happen in animal guts, manure, wastewater, soil, or other environments where bacteria are present. That is why antibiotic resistance is not only a medical concern, but also an agricultural, environmental, and food-systems issue. Bacterial populations increase rapidly as they survive against antibiotics by developing resistance traits. Poor management and non-prescribed use of antibiotics increases the chances for the development of antibiotic-resistant bacteria. This is why stewardship is important.

Antibiotic Resistance Is Different from Antibiotic Residues

Antibiotic residues are different from antibiotic resistance, and they are referred to as traces of antibiotic drugs that may remain in food if withdrawal times are not followed. A producer may follow withdrawal times correctly and still face antibiotic resistance issues if resistant bacteria are present.

How Resistant Bacteria Can Spread Through the Food System?

Resistant bacteria can move through food systems in several ways. They may be carried by livestock without causing an obvious disease. They may travel through manure, soil, and water, and contaminate housing or equipment. Resistant bacteria can also be transferred during harvest, slaughter, milking, egg handling, transport, or processing. People may then be exposed through contaminated food, direct animal

contact, environmental exposure, and cross-contamination in the kitchen or processing environments. The U.S. Centers for Disease Control & Prevention (CDC) specifically notes that antibiotic-resistant bacteria can spread to people from food and livestock, and WHO describes the food chain as an important pathway.

Why Producers Should Care?

Antibiotic resistance matters to producers for several reasons. First, resistant infections in animals can be harder and more expensive to treat. Second, resistant bacteria can affect market confidence, regulatory attention, and public trust in food production systems. Third, when resistant bacteria are linked to foodborne illness in people, the consequences can extend far beyond the farm. CDC notes that antibiotic-resistant bacteria can spread to people through food and animal products.

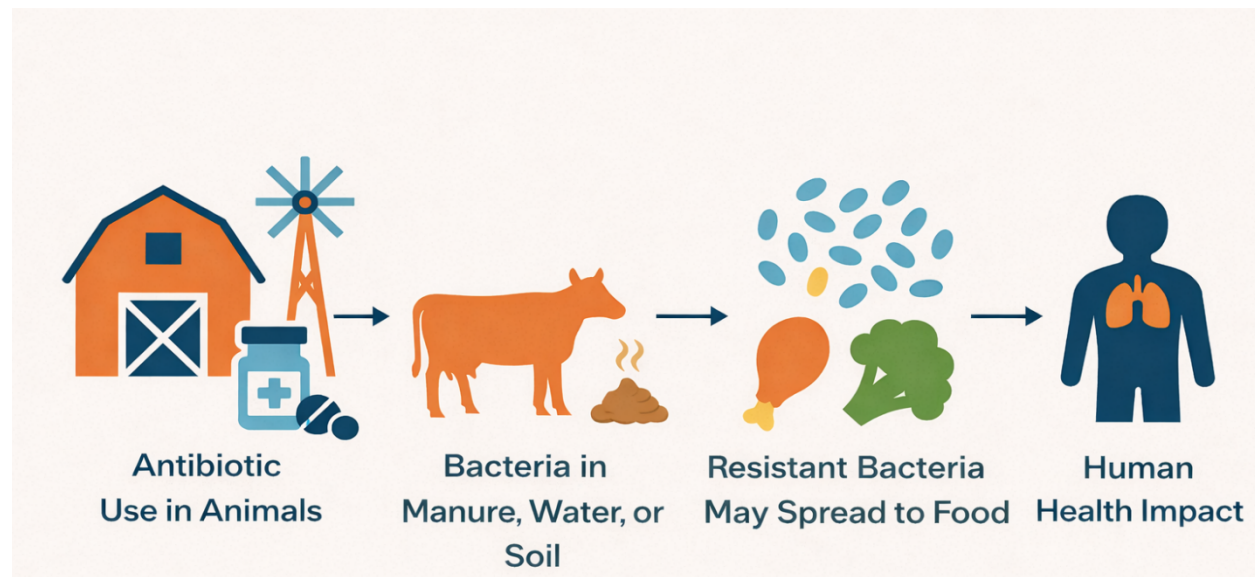


Figure 1. Pathways of Antibiotic Resistance Through the Food System

Antibiotic Use in Agriculture

Antibiotics play a significant role in animal health when animals are sick and need treatment. However, not following best practices, such as when to use antibiotics, how long to use them, and how much to use, can result in poorly targeted use that contributes to antibiotic resistance over time. WHO has encouraged limiting the routine use of antibiotics for growth promotion or routine disease prevention, especially when improved husbandry and preventive management practices can be used instead. FAO also emphasizes responsible antimicrobial use within agricultural systems. Antibiotics may be used in animal agriculture to treat disease, control disease in a group when justified, or prevent disease under veterinary direction in specific situations. However, long-term risk increases when antibiotics are used without purpose, good records,

failure to use the right dosage and duration, or strengthening management practices that reduce disease pressure in the first place.

What Increases Risk on Farms and in Food Production?

Antibiotic-resistant bacteria are more likely to spread under certain conditions, including:

- poor animal health or chronic disease pressure
- overcrowding or stressful housing conditions
- weak biosecurity
- poor sanitation of housing, tools, transport equipment, or water systems
- manure mismanagement
- contaminated water sources
- poor recordkeeping on treatments
- lack of veterinary oversight
- weak worker hygiene and handwashing
- poor segregation between sick and healthy animals

This does not mean every farm with one of these challenges has a resistance problem. Rather, these are conditions that can increase disease pressure, antimicrobial use, or opportunities for bacteria to spread. That is why resistance prevention is closely linked to everyday herd, flock, facility, and environmental management.

What Producers Can Do?

1. Responsible Use of Antibiotics

Use antibiotics only when they are truly needed, according to label requirements and under veterinary direction. Good stewardship includes choosing the right drug, dose, route, and duration, while keeping accurate treatment records. Responsible use protects both animal welfare and the effectiveness of antibiotics over time. WHO and FAO both support stewardship approaches that reduce unnecessary use while maintaining animal health.

2. Prevent Disease Before Treatment is Needed

The best way to reduce antibiotic use is to take steps to prevent disease. This includes vaccination programs where appropriate, strong nutrition, clean water, biosecurity, ventilation, stocking density management, stress reduction, sanitation, and prompt identification of sick animals.

3. Strengthen Hygiene and Sanitation

Cleaner facilities help reduce overall bacterial load and lower opportunities for spread. Depending on the production system, this may include pen sanitation, milking hygiene, egg handling sanitation, wash water management, worker hygiene, boot cleaning, and segregation of dirty and clean areas. These practices support both food safety and biosecurity by helping reduce the movement of disease-causing bacteria within animal areas and across the food production environment.

4. Manage Manure and Water Carefully

Manure runoff, wastewater, and irrigation water can all play a role in moving bacteria through the environment. Producers should minimize runoff risks, protect water sources, handle manure carefully, and pay attention to where waste moves after leaving animal areas.

5. Train Workers

Workers should be aware that their day-to-day actions affect both food safety and resistance risk. Proper handwashing, cleaning of tools, separation of sick animals, recordkeeping, and following treatment instructions can help reduce the spread of antibiotic-resistant bacteria. Proper training helps connect science-based recommendations to routine behavior.

What Consumers and the Public Should Know and Practice?

Antibiotic resistance is not limited to farms or food production. It is a broader health issue influenced by antibiotic use and the spread of antibiotic-resistant bacteria across human medicine, animal agriculture, healthcare settings, communities, wastewater, and the environment. Because antibiotic-resistant bacteria and resistance genes can move among people, animals, food, water, and the environment, this issue is often described through a One Health approach. In summary, the effective use of antibiotics is a joint effort of management at different levels, including human health, animal care, food production, and environmental stewardship.

Monitoring and Surveillance - NARMS:

The National Antimicrobial Resistance Monitoring System (NARMS) is a U.S. surveillance program that uses a One Health approach to track antibiotic resistance in important foodborne and human intestinal bacteria, as well as in retail meats and livestock. From a food safety standpoint, the concern is not simply whether bacteria are

present, but whether they are present in forms that may be harder to control and treat if they cause illness. Common foodborne bacteria of concern include *Salmonella*, *Campylobacter*, and certain strains of *E. coli*. To address this, the NARMS program, which is a partnership among the United States Food and Drug Administration (FDA), CDC, the United States Department of Agriculture (USDA), and state and local health departments, aims to identify resistance trends, detect emerging concerns, and support public health action. The FDA's NARMS program, especially, tracks resistance in enteric bacteria (bacteria that normally live in or affect the digestive system (intestines)) in retail meat and seafood products because they can move across the human-animal-food interface, and resistance patterns can affect treatment choices and public health responses.

Public misconceptions

Myth: Antibiotic resistance means the body becomes resistant.

Fact: Resistance develops in bacteria, not in the person or animal.

Myth: If antibiotic residues are not present, resistance is not a concern.

Fact: Residues and resistance are different issues. Food can be residue-compliant and still be part of a resistance pathway if resistant bacteria are present.

Myth: The only solution is to stop treating animals.

Fact: Sick animals still need appropriate care. The goal is responsible, targeted use combined with strong prevention and management.

Conclusion

Antibiotic resistance is not just a medical problem but a food systems issue that connects animal health, farm management, food safety, environmental stewardship, and public health. For producers, the most important message is that this problem can be managed through responsible use of antibiotics, disease prevention, strong sanitation, good husbandry, careful manure and water management, and worker training. A practical One Health and food systems approach helps protect animal health while also helping to preserve the effectiveness of antibiotics for the future. This makes antibiotic stewardship an important part of both good production practice and responsible food safety management.

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Figure 1:

Illustration generated using Microsoft Copilot from author-developed prompts and adapted from information provided by WHO, FAO, CDC, and FDA on antimicrobial resistance and food systems.

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