

Antimicrobial Resistance and the Food Supply



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Will antimicrobials, such as antibiotics prescribed by your doctor, work when you really need them? Have bacteria developed a resistance to those drugs? The evidence is mounting to show that use of antimicrobials in humans to prevent or treat illness and in livestock to promote growth, and prevent or treat illness may affect the way these drugs work when humans need them to fight a bacterial infection. This publication explores the relationships between the use of antimicrobials and their effectiveness in fighting diseases.

Many people take antimicrobials for granted. They don't remember when diseases like whooping cough threatened the U.S. population. However, diseases such as anthrax have now caused concern. When the anthrax-causing bacteria appeared in late 2001, many people hoarded an antimicrobial called Cipro to protect themselves and their families in the rare case of an infection. Some people take low levels of other antimicrobials to ward off acne and other skin problems. Many of us ask our physicians for antimicrobials when we don't feel well. We rely on these medicines to cure infection. Antimicrobials also are used in the agricultural industry. We depend on them for our health and livelihood, and yet the more we use them, the more bacteria may become resistant to them.

What are antimicrobials?

Antimicrobials kill or inhibit growth of bacteria. The term antimicrobial refers to both natural "antibiotics" and synthetic compounds. Alexander Fleming discovered

the first naturally occurring antibiotic, penicillin, in 1927. Early antibiotics were made entirely from natural compounds, but most modern commercial antibiotics are changed in the lab to make them more effective. Some antimicrobials are made entirely synthetically.

How do they work?

Some antimicrobials inhibit bacterial growth, giving the person's defenses a chance to fight off invading bacteria. One antimicrobial, tetracycline, works by entering the harmful bacterial cell and attaching to internal components that make new proteins. Those bacteria cannot grow and divide if new proteins cannot be made. Some antimicrobials kill bacteria. Penicillin stops proper development of new cell walls in bacteria.

What is antimicrobial resistance?

Some bacteria develop antimicrobial resistance, which is the ability to resist antimicrobial medicines. Harmful bacteria that encounter an antimicrobial substance fight to avoid being killed by the medicine. The use of antimicrobials can also promote the development of resistance in bacteria that are not the target of the medicine. When medicines attack harmful bacteria, they may also attack other bacteria present, including beneficial bacteria that help protect us from the harmful ones.

Bacterial resistance in humans spreads easily to the surrounding area and to other people (Figure 1). For example, if one family member takes an antimicrobial to prevent acne for an extended period of time, others in the family may develop

resistant bacteria on their skin. Heavy use of antimicrobials in hospitals or on farms results in increased levels of resistant bacteria in people and animals not being treated with the medicines. Travel can spread antimicrobial resistance.

How does use affect the problem?

Antimicrobial use and misuse has spread since the 1940s. In 1954, 2 million pounds of antimicrobials were produced in the United States. Today, that amount is more than 50 million pounds. About 25 million pounds are for human use, and about half of that may be misuse. In the early 1990s, a large number of antimicrobials were prescribed for colds and upper respiratory infections. Antimicrobials offer little relief from such ailments. From 1992 through 2000, the overall prescription rate for these drugs dropped by 25 percent, but the rates for clarithromycin, quinolones and amoxicillin increased significantly.

The appropriate use of antimicrobials is to cure bacterial infections. These drugs are not effective against viruses.

How is this a food safety issue?

The Food and Drug Administration has been concerned about growing numbers of drug-resistant human pathogens such as *Staphylococcus aureus*, *Escherichia coli* O157:H7, various species of *Campylobacter* and *Salmonella*, and *Listeria monocytogenes*. These organisms are known agents of foodborne illnesses.

Each year, millions of people get sick from eating food contaminated with bacteria such as *Salmonella*. Infections in those most likely to have serious complications, particularly the young and the elderly, may be treated with antimicrobials. Some *Salmonella* and *Campylobacter* species, however, have become resistant to these medicines.

Today, more people may actually become ill from

foodborne pathogens than in the past. A small number of antimicrobial-resistant bacteria may make someone ill, but in the past, it often took larger numbers of bacteria to overcome the body's normal bacteria population.

The food supply also may be the source of antimicrobial-resistant bacteria. Harmless bacteria in food-producing animals can become resistant to antimicrobials. These resistant organisms may be transmitted to humans in food. Once inside the human gastrointestinal tract, these organisms may pass their resistance to harmful bacteria.

What about agricultural use?

More than 40 percent of the antimicrobials used in the United States are used in animal production and other agricultural enterprises. Drugs are used to treat sickness or to prevent infection in animals. For example, in chicken and turkey flocks, antimicrobials may be mixed into feed or water to prevent disease. The animals are not treated individually, but as a flock. Drugs are also used to treat mastitis and respiratory diseases in cattle.

Antimicrobials called "antibiotic growth promoters" are also used to promote growth in animals. They are given in subtherapeutic amounts in feed, often for weeks or months. Long-term exposure to drugs promotes animal growth, but the amounts are too low to cure infection. This regime provides a good opportunity for bacteria in the animals to develop

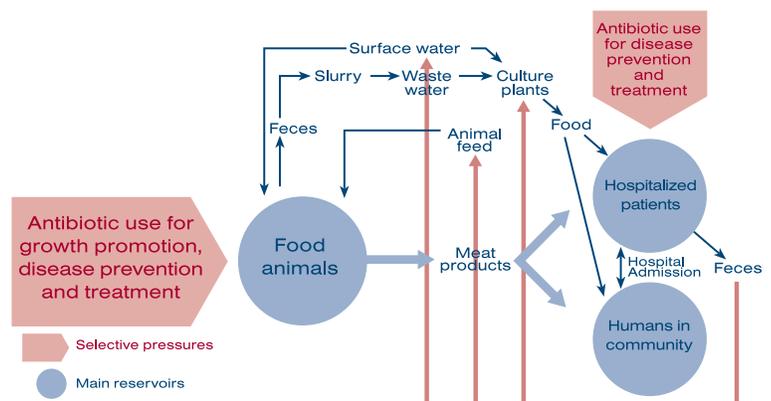


Figure 1. Use of antimicrobials in humans and animals.

resistance factors. Then, those resistant bacteria pass to animal caretakers, the immediate environment, people who handle and prepare raw meats, and consumers who eat undercooked or raw meats.

Antimicrobials are used in other agricultural practices, too. They may be applied as aerosol sprays to fruit trees to prevent bacteria infection. Aerosols may travel to other plants and animals and encourage the development of resistant bacteria. Resistant organisms may make their way through the food chain via fruits and vegetables to take up residence in the intestinal tracts of human consumers.

Resistant pathogenic bacteria have been isolated from many foodstuffs including beef, pork, lamb, poultry, fish, shellfish, alfalfa sprouts, bean sprouts, lettuce, apple juice and other fruits and vegetables.

The runoff or discharge of farm wastes may include antimicrobials that potentially lead to a build-up of resistant organisms. Some antimicrobials enter the water and soil this way. Antimicrobial residues can be found in some ponds and rivers, and in soils where metabolites of these drugs may bind to organic matter. Health effects of these residues are unknown.

How is antimicrobial use in humans different from use in animals?

Generally, in humans, antimicrobials are used to treat illness. Occasionally, they are used to prevent disease. Sick animals are also given antimicrobials. Frequently, however, whole flocks or herds are treated, including animals that are not sick.

Antimicrobials are not given to humans to promote growth, but this use is frequent in animal agriculture.

What is the relationship between animal drugs and human drugs?

The majority of drugs used in animals are also those used to treat humans. These antimicrobials include tetracyclines, sulfonamides, penicillins, macrolides, fluoroquinolones, cephalosporins, aminoglycosides and streptogramins.

Key Terms to Know

Antibiotic - a chemical substance produced by a microorganism that can kill or inhibit the growth of another organism. One type of antimicrobial agent.

Antimicrobial - a substance that kills microorganisms or suppresses their multiplication or growth. May be naturally produced or made synthetically. Includes antibiotics.

Antimicrobial resistance - the ability of some organisms to resist or fight medicines that should inhibit or kill the organisms.

Microorganism - microscopic organism such as bacteria.

Subtherapeutic - an amount of a drug given that is below the level needed to cure infection.

Virus - minute infectious agent without independent metabolism, requiring living host cells.

How does the increase in antimicrobial resistance affect human health?

If an ill person is treated with a drug to which the bacteria are resistant, the medicine will not be effective. The illness may last longer, be more severe or more expensive to treat.

What is being done to slow antimicrobial resistance?

Agriculture. Reduced antimicrobial use in livestock and fruit production, along with improved hygiene, may help decrease resistant organisms in farm populations. The American Veterinary Medical Association has developed new guidelines for drug use in animals.

Consumers. Appropriate human use of prescription medicines is important. Use all of the medicine for the entire time designated. Do not save pills for another time after you start to feel better. Your infection may not be eliminated, and you run the risk of allowing remaining microorganisms to become even more resistant and harder to eliminate.

- Do not demand antimicrobials for cold or flu viruses. They are not effective.

- Discard remainders of any old medicines. Avoid self-treatment with unused drugs.
- Minimize use of antibacterial hand cleansers and lotions.
- Wash hands and surfaces with soap and water to prevent cross-contamination.
- Learn more about this health issue. Share information with your family and friends.

Health Care. Physicians can attempt to identify the cause of an illness before prescribing antimicrobials. Selecting a specific drug instead of a broad-spectrum medicine can make a difference.

Hand washing after examining each patient is important. Hospitals can separate infected patients from others. Health workers should be gloved and gowned.

Pharmaceutical Industry. The industry is seeking new antimicrobials, but it takes time to develop new medicines, complete necessary testing and gain approvals.

Regulatory agencies. The U.S. Food and Drug Administration and the U.S. Department of Agriculture are working to slow antimicrobial resistance. They have established the National Antibiotic Resistance Monitoring System to track drug resistance and have developed strategies to reduce development of resistant organisms.

Greater awareness and action will stop the rise of antimicrobial resistance. Our health depends on it.

RESOURCES

The American Veterinary Medical Association. Judicious therapeutic use of antimicrobials www.avma.org/resources/

The Centers for Disease Control and Prevention www.cdc.gov

The Centers for Disease Control and Prevention - National Antibiotic Resistance Monitoring System (NARMS) www.cdc.gov/narms/

The U.S. Food and Drug Administration www.fda.gov

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This paper was reviewed by Larry Hollis, DVM, Beef Veterinarian and Mike Bradshaw, Ph.D., Wellness and Safety Specialist.

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In either case, credit Karen Pesaresi Penner, *Antimicrobial Resistance and the Food Supply*, August 2003.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service , Manhattan, Kansas

MF-2593

August 2003

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Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating. Marc A. Johnson, Director.