



# Antimicrobial Resistance in Agriculture

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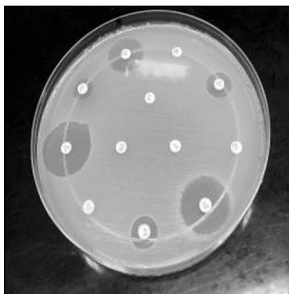


Figure 1. Petri dish showing the effects of various antimicrobial agents on the growth of bacteria. A disk with no clear zone indicates that the bacteria are resistant to the antimicrobial and continue to grow in its presence.

**A**ntimicrobial drugs have played a vital role in health management of both humans and animals for more than 50 years. In agriculture, antimicrobials are used to treat, control or prevent disease caused by micro-organisms, and to improve production or growth.

The use of antimicrobials in animals that are ready for market has always been closely monitored. Until recently, the focus has been on antimicrobial residues in food intended for human consumption. Some residues can lead to allergic reactions in a small percentage of the population. Other antimicrobial residues may increase the risk of other adverse health outcomes, such as cancer, and are banned by Health Canada for use in food-producing animals. The Canadian Food Inspection Agency and the Food Inspection Branch of the Ontario Ministry of Agriculture and Food (OMAF) continue to monitor for these residues to ensure compliance by the agricultural industry.

There is increasing concern that the use of antimicrobials in agricultural production systems may contribute to antimicrobial resistance, primarily in zoonotic bacteria. Zoonotic bacteria can cause disease in both animals and humans, and are usually transferred from animals to humans by direct contact or through food.

The other areas of concern are transference of resistance, and multi-drug resistance. Resistance genes can transfer from bacteria of agricultural origin to disease-causing bacteria of human origin. Disease caused by bacteria that are multi-drug resistant can result in compromised treatment options, prolonged recovery, or in the worst case, treatment failure.

## QUESTIONS AND ANSWERS

### Q. What is an antimicrobial?

A. Antimicrobials are natural, semi-synthetic or synthetic substances, including antibiotics, which inhibit or kill micro-organisms (microscopic life forms such as bacteria, fungi, mycoplasmas, rickettsias, chlamydiae and protozoa).

### Q. What is an antibiotic?

A. Antibiotics are natural substances produced by micro-organisms that, at low concentrations, are able to inhibit or kill other micro-organisms. (See Figure 1.)

### Q. What is antimicrobial resistance?

A. Antimicrobial resistance is the ability of a micro-organism to evade the inhibiting or killing action of an antimicrobial.

Micro-organisms are naturally or intrinsically resistant to particular antimicrobials because they do not have the cellular sites required for antimicrobial action. Antimicrobial resistance also refers to the acquired

ability of a micro-organism to survive exposure to an antimicrobial to which it normally is susceptible.

**Q. How is antimicrobial resistance acquired?**

A. Antimicrobial resistance can be acquired in one of two ways:

- Resistance can arise spontaneously. Bacteria are constantly changing in order to survive and mutations in the genetic code do occur as a random event.
- Resistance can be transferred amongst related and unrelated bacteria through DNA exchange - "gene swapping". This ability to share genetic information is the major way that multi-drug resistance develops, and relatively quickly.

**Q. What is multi-drug resistance?**

A. If bacteria acquire resistance to more than one antimicrobial they are called multi-drug resistant. Bacteria with resistance to most or all antimicrobials are often referred to in the popular press as "Superbugs". Multi-drug resistant pathogenic (disease-causing) bacteria may compromise health treatment choices for both animals and humans, prolong recovery, or lead to treatment failure.

**Q. How does antimicrobial use contribute to the development of antimicrobial resistance?**

A. Overuse and misuse of antimicrobial drugs contribute to the development of antimicrobial resistance.

The development of resistance is encouraged by overuse of an antimicrobial when it is the only treatment or control measure available. For example, various pathogenic bacteria developed resistance to penicillin soon after its introduction into both human and veterinary medicine. The development of antimicrobial resistance is also encouraged by widespread use of the antimicrobial when it is not required (misuse). Treatment of upper respira-

tory viral infections with antibiotics has led to an increasing incidence of resistant bacteria causing pneumonia in humans. In agriculture, overuse and misuse of antimicrobials used to improve growth, prevent disease, and to treat disease can contribute to resistance.

**Q. Are antimicrobial resistance and antimicrobial residues linked?**

A. Antimicrobial resistance and antimicrobial residues are separate issues. Antimicrobial residues refer to trace amounts of antimicrobials present in food (such as meat, eggs, milk, vegetables and fruits). The occurrence of residues above acceptable safety limits is uncommon but can be an indicator of irresponsible use of antimicrobials. With residues, the health implications of the residue itself are of concern; with antimicrobial resistance, the risk is related to the development of resistant micro-organisms, like bacteria, that affect animal or human health.

**Q. Is antimicrobial use in agriculture responsible for the development of antimicrobial resistance in human pathogens?**

A. Antimicrobial use anywhere can lead to the development of resistance. Although the media have sometimes indicated agricultural use of antimicrobials is a large factor contributing to resistance in bacteria infecting humans, in fact, the relative contributions of human, agriculture and pet antimicrobial use to the overall problem of resistance are still unknown. Antimicrobial resistance in human pathogens is largely due to the overuse or misuse of antibiotics in human medicine.

**Q. Should the use of antimicrobials in agriculture be stopped?**

A. No. Antimicrobials used in agricultural production systems contribute to: efficient production, control of animal and crop diseases, and a reduction of disease spread from animals to humans.

Antimicrobials need to be used prudently in agriculture, human medicine and public health applications. Prudent use means antimicrobials are not used excessively or indiscriminately. Many organizations have developed or are developing prudent use guidelines to cover all antimicrobial usage in animals and people.

**Q. Is antimicrobial resistance solely a European issue?**

A. Antimicrobial resistance is a global issue. To date, countries in Europe have imposed the most restrictions on the use of antimicrobials in animal agriculture. In 1986, Sweden banned antimicrobials in feed for the purpose of improving animal growth. Finland has done so as well. Denmark banned all antimicrobials for growth promotion purposes in 1999. Since 1997, the Commission of the European Union has banned most antimicrobials for growth promotion and the adoption of a new regulation to ban the remaining antimicrobials is expected to occur by 2006.

In the U.S., the Food and Drug Administration has changed how antimicrobials can be used in veterinary medicine and has issued a guidance document outlining the risk assessment process for new veterinary antimicrobial drugs with respect to antimicrobial resistance development and impact on human health. Surveillance networks have also been established to monitor antimicrobial resistance trends in bacteria of human and animal origin.

**Q. What is Canada doing about antimicrobial resistance in agriculture?**

A. The Veterinary Drugs Directorate (VDD) of Health Canada is responsible for the approval and registration of all antimicrobials for use in agriculture. A new drug must satisfy extensive product efficacy, manufacturing and safety (animal, environment, and human) criteria before being approved. The VDD is currently developing a risk management strategy

to reduce the human health impact of antimicrobial resistance due to use of antimicrobials in animals. As risk factors become better defined, it is possible that restrictions on use of particular antimicrobials will be imposed.

The Canadian Integrated Program for Antimicrobial Resistance Surveillance (CIPARS), in collaboration with OMAF, other government agencies, industry and academia, is developing an integrated national surveillance program of antimicrobial resistance and antimicrobial use in Canadian agriculture and its relation to human health. The first annual report was released in 2004.

The Canadian Committee on Antimicrobial Resistance (CCAR) has the mandate to facilitate and promote programs related to surveillance, optimal antimicrobial use, and infection prevention and control to limit antimicrobial resistance. A National Action Plan to control the development of antimicrobial resistance in both humans and animals was released in 2004.

The Canadian Veterinary Medical Association is developing prudent and judicious antimicrobial use guidelines for veterinarians working with swine, beef or dairy herds and poultry flocks.

**Choices Today On Your Farm**

- Consider using antimicrobials only when clinical signs of disease are evident.
- Consult your veterinarian before using any antimicrobials for livestock to make sure the disease is treatable with antimicrobials .
- All off-label use of antimicrobials in livestock feed requires a veterinary prescription.
- Follow prescription or label directions for storage, use, handling and withdrawal times.
- Prevent diseases by implementing good herd or flock health, nutrition, animal comfort, hygienic and biosecurity practices.
- Periodically re-evaluate the benefit of any use of antimicrobials to improve growth or prevent disease. Discontinue use if there is no benefit.

- Consider the use of alternatives to antimicrobials to improve production or growth such as alternate feeds and feeding strategies, direct-fed microbials, acidifiers, enzymes, and oligosaccharides.

### Choices Today At Home

- Don't ask for antibiotics if your doctor says you have a viral infection.
- Take antibiotics as directed by your doctor or pharmacist.
- Finish your prescription completely. Do not save antibiotics for another time.
- Never take another person's antibiotics.
- Washing hands frequently with soap and water is the best way to stop the spread of micro-organisms.

*This Factsheet was updated by Kim Klotins, Antimicrobial Resistance Specialist, OMAF. Original author was Dawn Pate, OMAF. This information was provided courtesy of OMAFRA Livestock Technology Branch and cannot be reprinted without permission.*



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