

Antimicrobial Resistance



INTRODUCTION TO THIS GUIDE

GETTING STARTED

The purpose of this teaching guide is to reinforce concepts learned in the online [Pharmacology module](#) by providing additional resources that provide opportunity for in depth discussion as well as active learning activities that can be used in the classroom or as out of class assignments. Approximate times for each [classroom active learning technique](#) are provided so that instructors can pick those that fit best with their teaching goals and time allotted. This guide is meant to be used as an electronic guide in order for the end-user to use the resources (reading materials and videos) provided in each section.

PHARMACOLOGY

PREPARATION

In preparation to teach the Pharmacology module:

- Review the [Pharmacology module](#) online at the [AMRLS site](#).
- Print and distribute the [pre-test](#) for this module. At the end of the class, hand out the post-test (same quiz) to see if the learning has been increased.

VOCABULARY

Outcomes:

1. Define terms related to the Pharmacology module.
2. Use the pharmacology terms to aid in the completion of the exercises.

Activites:

- Define the following:
 - MIC, MBC and MPC
 - Metaphylaxis
 - Empirical therapy
 - Definitive therapy
- Give participants a vocabulary list of terms to define for this section.

REFERENCES

The references listed below may be used in conjunction with teaching this module and/or as an assignment before/after teaching Pharmacology.

- [Pharmacology, Part 1: Introduction to Pharmacology and Pharmacodynamics](#)
- [Pharmacology, Part 2: Introduction to Pharmacokinetics:](#)
- [What is antimicrobial stewardship?](#)
- [ACVIM Consensus Statement on Therapeutic Antimicrobial Use in Animals and Antimicrobial Resistance](#)
- [ACVIM Consensus Statement on Therapeutic Antimicrobial Use and Antimicrobial Resistance](#)

HISTORY OF THE PRE-ANTIBIOTIC ERA AND THE GOLDEN AGE OF ANTIBIOTICS AND SYNTHETIC ANTIBACTERIAL DRUGS

Outcomes:

1. Discuss the early history of antimicrobials and antimicrobial resistance.
2. Summarize current problems and/or lessons learned with antimicrobial resistance.
3. Participate in awareness by asking students to tweet or make a bumper sticker.

Preparation:

- Watch [The Discovery of Penicillin and Antibiotics](#)
- Review [timeline](#) to understand antibiotic resistance identified and antibiotic introduction
- Peruse the [CDC Antibiotic Resistance Threats](#) online resource
 - Show pages 13 & 14 – as introduction to next section

Activities:

- Activity (10-15 minutes)
 - Divide students into groups of 2 for a "[Think-Pair-Share](#)" discussion.
 - Ask students to consider the following questions based upon their reading of the history of antibiotics: What human activities led to the first reports of antimicrobial resistance? What lessons can be learned from this and how might we apply those lessons today to help slow the rise in antimicrobial-resistant infections?
 - Ask students to come up with a "Tweet" or Bumper Sticker Moto that encapsulates what they have just discussed. The top three can be announced at the next class meeting.

THE ERA OF ANTIMICROBIAL RESISTANCE

Outcomes:

1. Debate FOR the use of critically important antibiotics in animals, and AGAINST the use of critically important antibiotics in animals.

2. Discuss ethical situations as related to giving companion animals human antibiotics and the balance of health of an animal and the public good.

Preparation:

- Look at the table of Critically Important Antibiotics (CIA) in human medicine as defined by the World Health Organization (WHO): [CIA](#)
- Read the following articles about restricting or banning the use of antibiotics in animals:
 - [WHO suggests antibiotic ban in livestock](#)
 - [Why We Need to Ban the Use of Antibiotics in Farm Animals Now](#)

Activities:

- Activity (45 minutes)
 - Debate: For small classes, divide students into four groups. One group will provide arguments **FOR** the use of critically important antibiotics in companion animals, while the other group will provide arguments **AGAINST** the use of critically important antibiotics in companion animals. A third group will provide arguments **FOR** the use of critically important antibiotics in food animals, while the fourth group will provide arguments **AGAINST** the use of critically important antibiotics in food animals. Allow 15 minutes for groups to come up with their arguments.
 - Use the debate format below:
 - First Affirmative Speaker- 2 minute introduction
 - First Negative Speaker- 2 minute introduction
 - Second Affirmative Speaker- 2 minutes to disagree
 - Second Negative Speaker- 2 minutes to disagree
 - Negative Summary/Rebuttal Speaker- 2 minutes conclusion
 - Affirmative Summary/Rebuttal Speaker- 2 minute conclusion
- Activity (15 minutes)
 - Divide students into groups of 2 or 3 for [think-pair \(trio\)-share](#) discussions.
 - Pose one (or more) of the following questions to the students:
 - Is it ever okay to use a last resort antibiotic for humans in a companion animal?
 - How does a veterinary prescriber balance the health of an animal (and the veterinarian's oath) and the public good?

ANTIMICROBIAL DRUGS: AN INTRODUCTION

Outcomes:

1. Discuss the different classes of antimicrobial drugs and how does each class generally acts to arrest the multiplication of microbes or kill them.
2. Create a summary table of drugs classes and their common use in veterinary medicine.
3. Discuss how mechanisms of action explain whether a drug has a bactericidal or bacteriostatic effect.

Preparation:

- Review [Mechanism of Action](#) figure and discuss DNA, Cell Wall and Ribosomes
 - For further review – watch [Antibiotics - Mechanism of Action](#)
- Discuss MIC, MBC and MPC as it relates to the [chart](#).

Activities:

- Activity (30 minutes)
 - Create a table that summarizes the drug classes, drugs within each class commonly used in veterinary medicine, and the target/mechanisms of action of each drug class.
 - How do the mechanisms of action explain whether a drug has a bactericidal or bacteriostatic effect? This can be an in-class discussion, a small group-discussion or the focus of a [one-minute paper](#).

ANTIMICROBIAL DRUGS IN THE BODY AND DRUG DOSING

Outcomes:

1. Discuss ADME, veterinary antibiotics and bacteria related to antimicrobial drugs.
2. Compare and contrast 2 drugs - discussing the effects, how they are related to small/large animals, etc.
3. Propose solutions for canine patients with *E. coli* urinary tract infections.

Preparation:

- Discuss ADME (absorption, distribution, biochemical metabolism, excretion). Students could view five short videos on YouTube, starting with the first one at [Pharmacokinetics 1 - Introduction](#)
- Review veterinary antibiotics
- Discuss bacteria related to antimicrobial drugs
 - Difference between kill versus growth inhibition
 - Drugs and bugs in an animal host (spectrum, pharmacokinetics, etc.)

Activities:

- Activity (60 minutes)
 - Compare and contrast 2 drug inserts from the same class (labeled for different animals)
 1. [Convenia](#)
 2. [Naxcel](#)
 - Discuss instructor-generated questions in a class session or take a short quiz on the label content. Examples of questions to ask may be:
 - Compare and contrast these two 3rd generation cephalosporins. What is the T_{1/2}, species of animal the drug for which the drug is intended? Do the effects linger in the same amount of time?
 - Would increasing the dose give a better effect? Would increasing the dosing frequency give a better effect?
 - Find a first generation cephalosporin used in either small or large animals: what is the difference in spectrum of activity?
- Activity (15 minutes)
 - Divide students into groups of 2 for a [Think-Pair-Share](#) activity (10 minutes). Provide the following clinical scenario and ask the following questions:
 - You have 2 canine patients, both with *E. coli* urinary tract infections. Patient 1 has a lower urinary tract (bladder) infection and patient 2 has an upper urinary tract (kidney) infection. Both amoxicillin and enrofloxacin have activity against *E. coli*.

- Which would you use to treat Patient 1 and Patient 2, and why?
- Discuss with the students (5 minutes) that the pharmacokinetics of amoxicillin (concentrating in the urine) allows for treatment of bladder infections, while the tissue penetration of fluoroquinolones are most appropriate for a kidney infection.

USAGE OF ANTIMICROBIAL DRUGS IN ANIMALS (THERAPEUTIC & NONTHERAPEUTIC)

Outcomes:

1. Discuss benefits and potential harms of antimicrobial drugs for animals.
2. Recall non-therapeutic uses of antimicrobial drugs.
3. List of factors that a veterinarian should consider when making decisions about if and when to institute antibiotic treatment

Preparation:

- Discuss the benefits of appropriate medical uses of antimicrobial drugs for animals
- Discuss the harms of antimicrobial drugs: to the patient, to the population
- Review the non-therapeutic uses of antimicrobial drugs
- Watch [Why Is Antimicrobial Stewardship Important?](#)

Activities:

- Activity (25 minutes)
 - Ask students to write a list of factors that a veterinarian should consider when making decisions about if and when to institute antibiotic treatment?
 - Students may work in pairs or small groups. They can share their responses in a class Google Document or write it on a white board.
 - Ask pairs/groups to join with another group to compare their lists. What was the same? How did the lists differ?
 - The lists can be compiled/summarized and posted on the class website (or shared via email).

ANTIMICROBIALS AND MEDICINE

Outcomes:

1. Recall ADA prophylactic antibiotic use.
2. Debate prophylactic antibiotic use in animals.
3. Report findings of prophylactic antibiotic use found in the literature.

Preparation:

- Read the statement from the American Dental Association regarding prophylactic antibiotic use
 - [ADA Antibiotic Prophylaxis](#)

Activities:

- Activity (35 minutes or a homework activity)
 - Provide this background: There are no evidence-based guidelines in veterinary medicine regarding preemptive use of antibiotics for dental cleanings. Some

- veterinarians and owners fear that patients with heart murmurs may develop endocarditis after a dental cleaning, and thus advocate for prophylactic antibiotic use.
- Ask students to form a stance on prophylactic antibiotic use in animals prior to dental cleanings.
 - Students should spend 15 minutes searching the veterinary medical literature for evidence to support their stance.
 - Students should write one paragraph, citing literature found, to support their stance.
 - Students should hand their paragraph to a student with the opposite stance to read. Allow 5 minutes for discussion.
 - Group discussion: Ask students "What are other appropriate and inappropriate uses of preemptive antimicrobials?"

WRAP-UP & NEXT STEPS

- **Discuss:** What was the most interesting point in we covered in class? What was the muddiest point?
- Print the [post-test](#) (same as pre-test); Distribute the test again to see if you've moved the mark on the student's learning experience.
- To conclude, please compile results of the pre/post test and your experience with this guide. Send your feedback and the results to ccapsonline@umn.edu.

DEFINITIONS OF CLASSROOM ACTIVE LEARNING TECHNIQUES

THINK-PAIR-SHARE

This activity asks students to think about an answer to a posed question. Next, the students turn to a partner in the class and share their ideas/answers. More information about this activity can be found at the [Think-Pair-Share](#) website.

ONE-MINUTE PAPER

This activity gives the students one minute to write down their answer to a posed question. After one minute the instructor either asks the students to share their thoughts with the class, share in a small group or with a partner, or hand the paper in for grading (perhaps as part of an attendance grade). For more information about this activity, visit the [One-Minute Paper](#) website.