OSU VMC ANTIMICROBIAL USE GUIDELINES

THE OHIO STATE UNIVERSITY COLLEGE OF VETERINARY MEDICINE

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The Antimicrobial Use Guidelines were created as a collaboration between The Ohio State University College of Veterinary Medicine Infectious Disease Signature Program and The Ohio State University Infectious Diseases Institute.

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INTRODUCTION

Prior to Alexander Fleming's work on the development of penicillin in 1928, the first antimicrobial drug was developed by Paul Ehrlich in the early twentieth century and released onto the market in 1910. Salvarsan, an arsenic-containing organic compound with anti-syphilitic properties, rapidly became the most prescribed drug in the world.

Other organoarsenic compounds soon followed Salvarsan onto the market, and shortly thereafter drug resistance developed. W.H. Brown and L. Pearce (The Rockefeller Institute for Medical Research) documented in 1921 that rabbits experimentally infected with syphilis and then treated with subcurative doses of Salvarsan became refractory to treatment over time.

The exponential development of antimicrobials throughout the twentieth and twenty-first centuries has in many ways improved the lives and lengthened the lifespans of humans and animals, but the development of drug resistance has not slowed. The Centers for Disease Control and Prevention (CDC) now warns that antimicrobial resistance is one of the most serious health threats facing mankind, sickening 2 million and killing more than 23,000 people per year in the United States. The number of veterinary patients similarly affected by resistance is unknown, but both companion and farm animals are not immune to the threat of antimicrobial resistance.

Resistant infections in animals of all species contribute to increased veterinary care costs and emotional strain for owners, endanger the food supply, and put the general public at risk. The fairly recent development of antimicrobial stewardship programs seeks to promote responsible use practices which will conserve antimicrobials for the future. One of the core elements of antimicrobial stewardship is educating medical practitioners about drug resistance and optimal prescribing.

The purpose of this guidebook is to give recommendations about which antimicrobial is the best choice for a given medical condition, both from the standpoint of treating the disease, and from a stewardship perspective.

Rachel C. Soltys, DVM

DISCLAIMER

Update 12/11/2020: The OSU Antimicrobial Stewardship Working Group (OSU-ASWG) is currently in the process of updating these guidelines to remain consistent with current veterinary literature and best practices. The updated guidelines are expected to be released in 2021.

Expected updates include:

- Relevant references included on individual antimicrobial drug pages
- Updated dosage/duration recommendations for ampicillin, ampicillin/sulbactam, amoxicillin, amoxicillin/clavulanic acid, ciprofloxacin, and enrofloxacin
- Updated drug classifications in the farm animal guidelines to further clarify appropriate label and off-label usage

If you have questions regarding our current AUG or would like additional information about the ongoing updates, please contact the OSU-ASWG at CVM-ASP@osu.edu.

The recommendations given in this guide are meant to serve as treatment guidelines, and are the opinions of the authors. We have attempted to verify that all information presented is correct, but ongoing antimicrobial research may invalidate these recommendations over time. When indicated, clinical judgement or consultation with the Antimicrobial Stewardship Working Group should be used to determine the best treatment choice and dosage for individual patients. If there is any doubt, please consult additional resources before making a treatment selection. Furthermore, these recommendations were developed for use at The Ohio State University Veterinary Medical Center and may not be appropriate for other settings.

Food Animal Disclaimer: Withdrawal times for meat and milk consumption must be established if not specifically stated on the label and the client must be informed that there is a withdrawal period. The Food Animal Residue Avoidance Databank (www.farad.org) is a valuable resource to establish withdrawal times for drugs used in an extra label manner.

REFERENCE TABLES

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SELECTED ANTIMICROBIALS AND RESTRICTION STATUS

Restriction Status Key

- **Unrestricted**
- **Selectively Use:** These antibiotics should NOT be used as empirical or first-line treatment. They should be used only when culture/sensitivity testing indicates they will be effective and other agents are inappropriate and/or ineffective. Approval does not need to be obtained from the Antimicrobial Stewardship Working Group prior to use of Selectively Use antimicrobials.
- **Protected**: Approval must be obtained from the Antimicrobial Stewardship Working Group prior to use of protected antimicrobials.
- **Permitted ELDU (extra-label drug use)**: Use of an approved drug in a manner that is not in accordance with the approved labeling, yet meets the conditions set forth by AMDUCA and FDA regulations; includes use in another species, use for a different indication, use at a different dose or frequency, and use via a different route of administration. Consult specific drug page in this booklet as well as product labels to determine definitive contraindications to use.
- **Prohibited ELDU**
- **Prohibited for Use in Food Animals**

Restriction Status Reference Table

Antimicrobial Name	Companion Animal	Equine	Major Species Intended for Food (i.e. cattle, pigs, turkeys, chickens)	Minor Food Species and Non-Food Animals (i.e. camelids, all species that are not major species listed above):
Amikacin	Unrestricted	Unrestricted	(Including other Aminoglycosides) Prohibited for Use in Food Animals [1]	Unrestricted
Amoxicillin	Unrestricted			Unrestricted
Amoxicillin-Clavulanic Acid	Unrestricted		Permitted ELDU	Unrestricted
Ampicillin	Unrestricted	Unrestricted	Permitted ELDU	Unrestricted
Ampicillin-Sulbactam	Unrestricted		Permitted ELDU	Unrestricted
Azithromycin	Unrestricted	Unrestricted		Unrestricted
Cefadroxil	Unrestricted			Unrestricted
Cefazolin	Unrestricted	Unrestricted		Unrestricted
Cefotaxime	Unrestricted	Unrestricted		Unrestricted
Cefovecin	Unrestricted			
Cefoxitin	Unrestricted			
Cefpodoxime	Unrestricted	Unrestricted		Unrestricted
Ceftazidime	Selectively Use			Unrestricted

Antimicrobial Name	Companion Animal	Equine	Major Species Intended for Food (i.e. cattle, pigs, turkeys, chickens)	Minor Food Species and Non-Food Animals (i.e. camelids, all species that are not major species listed above):
Ceftiofur		Unrestricted	Permitted ELDU [2]	Unrestricted
Cephalexin	Unrestricted			Unrestricted
Cephapirin			Permitted ELDU [2]	
Ciprofloxacin	Unrestricted			Unrestricted
Chloramphenicol	Unrestricted	Unrestricted	Prohibited for Use in Food Animals	Unrestricted
Clarithromycin		Unrestricted		
Clindamycin	Unrestricted			Unrestricted
Doxycycline	Unrestricted	Unrestricted		Unrestricted
Enrofloxacin	Unrestricted	Unrestricted	Prohibited ELDU	Unrestricted
Erythromycin		Unrestricted	Permitted ELDU	
Florfenicol			Permitted ELDU	Unrestricted
Gentamicin	Unrestricted	Unrestricted	Prohibited for Use in Food Animals [1]	Unrestricted
Imipenem	Protected	Protected		
Isoniazid			Selective Use	Selective Use
Lincomycin	Unrestricted			Unrestricted
Linezolid	Protected			Protected

Antimicrobial Name	Companion Animal	Equine	Major Species Intended for Food (i.e. cattle, pigs, turkeys, chickens)	Minor Food Species and Non-Food Animals (i.e. camelids, all species that are not major species listed above):
Marbofloxacin	Unrestricted			Unrestricted
Meropenem	Protected	Protected		
Metronidazole	Unrestricted	Unrestricted	Prohibited for Use in Food Animals	Unrestricted
Minocycline	Unrestricted			Unrestricted
Nitrofurantoin	Unrestricted		Prohibited for Use in Food Animals	Unrestricted
Oxytetracycline	Unrestricted	Unrestricted	Permitted ELDU	Unrestricted
Penicillin	Unrestricted	Unrestricted	Permitted ELDU	Unrestricted
Piperacillin-tazobactam	Protected			
Pradofloxacin	Selectively Use			Unrestricted
Rifampin	Unrestricted	Unrestricted		Unrestricted
Sulfonamides	Unrestricted	Unrestricted	Permitted ELDU	Unrestricted
Tulathromycin			Permitted ELDU	
Tylosin	Unrestricted		Permitted ELDU	
Vancomycin	Protected	Protected	Prohibited for Use in Food Animals	Protected

1. **Footnotes**

    1. Strongly discouraged, although not illegal, to use in animals intended for food. American Association of Bovine Practitioners (AABP) has a voluntary ban where practitioners promise not to use this class of antibiotic in cattle. (Back to Reference) ↩
    2. ELDU of ALL cephalosporin drugs, EXCEPT CEPHAPIRIN, is **restricted** in major food animal species (cattle, swine, turkeys, chickens). ELDU is **permissible** only for the therapeutic indications that are included on the product label (i.e. can use to treat conditions not specifically listed on the label). However, ELDU of cephalosporins (except Cephapirin) is **PROHIBITED** in situations where the intended use of the product deviates from the approved dose, treatment duration, frequency, and/or administration route on the product label as well as the intended use of a product in an unapproved major species or animal production class. In other words, it is permissible to use cephalosporin antibiotics to treat diseases not listed on the label, but you must use the labeled dose and route of administration in animals for which the drug has been approved. You may not use this class of antibiotics for growth promotion. (Back to Reference) ↩

LABORATORY REQUESTS AND SPECIMEN COLLECTION/TYPES

(Jump to Collection Table)
(Jump to Transport Media Table)

General Suggestions

The most useful culture specimens are from sites that are normally sterile (e.g. joint fluid, peritoneal fluid, blood) because any bacteria isolated from the site are likely to be causative. Culture of sites that are normally colonized by bacteria (e.g. nasopharynx, oral mucosa) are less likely to yield significant results. Normal flora can act as opportunistic pathogens, but their isolation by culture is not necessarily indicative of a true infection. An exception to this rule is if the clinician is trying to detect a pathogen not normally present in the non-sterile sites of normal animals (e.g. detection of *Streptococcus equi* subsp. *equi* from a nasal swab).

Tissues and fluids are the best samples to collect for culture. Larger samples tend to increase the likelihood of culturing a significant organism, particularly for anaerobic culture. Samples should be collected as aseptically as possible and quickly transported to the lab in a sterile and appropriate container or transport medium. Swabs are often a poor choice for sample collection because their small surface area will collect a very limited amount of material. If swabs are used for anaerobic culture, they must be placed within a transport medium (e.g. Port-a-Cul, BD Diagnostic Systems, Franklin Lakes, NJ) to minimize sample exposure to the air and loss of sample integrity.

Sample Collection and Submission for a Suspected Infectious Disease

The process of obtaining a culture and sensitivity does not start in the lab; it starts with you, the clinician, collecting the sample. A properly collected and transported specimen sample is essential to identifying and classifying the causative agent in an infectious disease. Here you will find some guidelines to optimize these procedures so that an accurate and reliable test result is obtained. If at any time questions may arise, call the laboratory for assistance.

Sample Collection and Submission

1. **Use an aseptic technique.** This will prevent possible contamination and improve the chances of detecting the causative pathogen.
2. **Label all samples.** Labeling will help the laboratory technicians know what tests are best for certain tissues.
3. **Properly obtain necropsy samples.** Collect non-GI tissue samples BEFORE opening the gastrointestinal tract. Tissue samples (lung, liver, spleen, kidney, etc.) should be 5 g or larger (no smaller than a golf ball). Place each tissue in a separate container or bag to prevent cross-contamination. If the intestine is to be cultured, tie off both ends of a segment and place in a separate container. Freezing tissues may be a good alternative if samples will not be delivered to the lab within 72 hours of collection. Contact the lab if there are concerns or if there is a need to discuss alternatives.
4. **Communicate with the laboratory.** If submitting a large number of samples (i.e. > 10, feces, milk, swabs), please call the laboratory for scheduling purposes.

Form Completion

1. **Be sure to specify the species of animal, tests requested and suspected diseases on the form.** This will help the laboratory personnel in inoculating the proper media. If the lab does not know what you are looking for, you may not get a diagnosis.
2. **Provide the laboratory with as much of the case history as possible.** If you are uncertain as to what could be causing a disease process, a detailed clinical history will help the specially-trained veterinarian assigned to the case create a list of differential diagnoses in addition to determining if additional testing is warranted. This will lead you closer to a possible causative agent.
3. **Specify the collection method and antibiotic use status when submitting urine samples for culture.** This will help the diagnostic laboratory correctly interpret culture results.

Sample Transport

1. **Most samples should be kept cold (but not frozen) from the time they are collected until they reach the diagnostic laboratory.** This reduces the chance of bacterial overgrowth and contamination, which could compromise testing. Exceptions to this rule, which should be kept at ROOM TEMPERATURE, include:
    1. Blood cultures (Blood culture bottles/Isolator tubes)
    2. Cerebrospinal fluid
    3. Joint fluids
    4. Trichomonas specimens (Preputial scrapings from bulls, vaginal scrapings or fluids from cows, fecal samples from cats)
    5. Dermatophytosis cultures (plucked hairs, scab material or scurf)
2. **Sample collection requires the correct transport media.** The following chart will help you select the best transport media for your sample. Contact the lab if any questions arise.

Suggested Samples and Tissues to Collect for Common Conditions and Diseases of Major Organ Systems

** Equine information adopted and modified from the Equine Infectious Diseases 2e, D.C. Sellon and M.T. Long, 2014.*

** Information applies to all categories unless specified*

Organ System/ Condition	Suggested Specimen Type(s)
Ears	• **Companion Animal**: Swab
Enterocolitis	• Feces (approximately 10-15 grams) • Loop of bowel close to site of lesion if collected from necropsy
Integument	• Skin biopsy (punch biopsy) • **Companion Animal**: Aspirate from unruptured pustule or vesicle (under a crust or edge of a collarette if pustules unavailable) • **Equine:** Aspirate from intact pustule or vesicle • **Farm Animal**: Aspirate from unruptured pustule or vesicle
Lower Respiratory Tract	• Tracheal secretions collected via transtracheal wash or bronchoalveolar lavage (BAL)
Musculoskeletal	• Joint fluid • Bone • **Companion Animal**: Affected muscle (after necrotic material is debrided) • **Equine and Farm Animal:** Affected muscle
Nervous System	• Cerebrospinal fluid • Brain/spinal cord if collected from necropsy
Pneumonia	• Tracheal secretions collected via transtracheal wash or bronchoalveolar lavage
Pyothorax	• Thoracocentesis • Recommend cytology (advise microbiology lab if filamentous organisms are identified on in-clinic cytology so that the laboratory personnel can take appropriate personal protection precaution) • Send fluids, not swabs, to the laboratory
Sepsis	• Blood culture • **Companion Animal:** Joint fluid
Urogenital – Abortion	• Fetal stomach contents, liver, lung, heart, heart blood, and spleen • Placenta • Dam serum
Urogenital – Urine	• **Companion Animal**: At least 1-2mL, ideally collected by cystocentesis in small animal species
Urogenital – Uterus	• Guarded swab

Transport Media for Sample Submission to the Diagnostic Laboratory [COMPANION]

Transport Media	Diagnostic Samples
Blood culture bottles	• Blood • CFS and joint fluids • **DO NOT** refrigerate-store at room temperature
Specialized transport systems for aerobic/anaerobic (Port-A-Cul® tubes; ACTM II® tubes)	• Tissues and swabs when aerobic, anaerobic, mycobacterial and/or fungal culture is required • Samples should be embedded in the agar
Port-A-Cul® vials; ACTM II ® tube	• Sterile fluids • Fluids from which aerobic, anaerobic, mycoplasma and/or fungal culture is required • Fluid should be placed at the top of the media
Red top tubes, sterile containers	• Urine • Fluids that only require aerobic culture
Screw top containers	• Feces • Milk
Sterile plastic bags (e.g. Whirl-pak)	• Tissues collected at necropsy (sample should be 5g or larger)
Sterile tube	• Fetal fluids (thoracic fluids, peritoneal fluids or heart blood) to be examined for *Leptospira* spp. by fluorescent antibody testing; if possible, 10% buffered formalin should be added at a rate of 1.5 ml per 20 ml fluid
Swabs	• **A swab should NEVER be submitted if biopsies/tissues, fluids, urine, feces or tissues are available. Therefore, submit fluids/tissues rather than swabs whenever possible.** • If a swab is the only option, submit multiple swabs (i.e. one for aerobic, one for anaerobic, one for fungus). ESwabs are a good alternative • Swabs that contain Amies or Stuart media are good for conventional aerobic culture. • Swabs containing gel media or ESwabs are ideal for aerobic and anaerobic culture • Samples transported on swabs **ALWAYS** require a transport media. Dry swabs (without transport media) are a poor choice for culture • Swabs are recommended in the case of ear, eye and uterine infections • Dacron swabs are recommended because cotton swabs are toxic to *Mycoplasma*

SUGGESTED TREATMENT OPTIONS BY CONDITION [COMPANION]

Quick Links

(C/S = culture and susceptibility testing)

Cardiovascular Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacteremia	• *Streptococcus canis*, • *Staphylococcus* spp. (*aureus, pseudintermedius, schleferi*), • *Escherichia coli*, • *Enterococcus* spp. • *Actinomyces* spp. • *Rickettsia* spp. • *Anaplasma* spp. • *Mycoplasma* spp.	(Ampicillin or Clindamycin) + Amikacin	(Ampicillin or Clindamycin) + Fluoroquinolone	C/S should guide treatment; add metronidazole if anaerobic component suspected.
Infectious Endocarditis	• *Streptococcus canis* • *Staphylococcus* spp. (*aureus, schleiferi, pseudintermedius, lugdunensis)* • *Escherichia coli* • *Enterococcus* spp. • *Pasteurella* spp. • *Acinetobacter baumannii* • *Bartonella* spp.	Ampicillin + Amikacin	Ampicillin + Fluoroquinolone	C/S should guide treatment.

Critical Care Conditions (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Peritonitis	• *Clostridium* spp. • *Escherichia coli* • *Mycobacterium microti* • *Enterococcus* spp. • *Pasteurella multocida*	(Ampicillin or Clindamycin) + Fluoroquinolone	(Ampicillin or Clindamycin) + Amikacin	C/S should guide treatment; add metronidazole if anaerobic component suspected.
Sepsis	• *Streptococcus canis* • *Staphylococcus* spp. (*aureus, pseudintermedius, schleferi)* • *Escherichia coli* • *Enterococcus* spp. • *Actinomyces* spp. • *Rickettsia* spp. • *Anaplasma* spp. • *Mycoplasma* spp.	(Ampicillin or Clindamycin) + Fluoroquinolone	(Ampicillin or Clindamycin) + Amikacin	C/S should guide treatment; add metronidazole if anaerobic component suspected.

Gastrointestinal Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Anal Sacculitis		Amoxicillin-Clavulanic Acid		Used in conjunction with lavage and local treatment.
Bacterial Enteritis	• *Campylobacter* spp. • *Salmonella enterica* • *Clostridium* spp. (*difficile, perfringens)* • *Salmonella* spp.	(See note)		Choose treatment based on most likely or culture-confirmed organism (e.g. enrofloxacin for salmonellosis, metronidazole for *Clostridium* species, etc.).
Cholangitis / Cholangiohepatitis		Beta-Lactam + Enrofloxacin	Beta-Lactam + Amikacin	Choice of beta-lactam should be guided by C/S.
Hemorrhagic Gastroenteritis	• *Anaerobiospirillum* spp. • *Clostridium perfringens*	Metronidazole		
Hepatic Encephalopathy		Metronidazole		
Periodontitis, Gingivitis, etc.		Clindamycin	Amoxicillin-Clavulanic Acid	Used in conjunction with dental cleaning.

Nervous System Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Discospondylitis		Amoxicillin-Clavulanic Acid *or* Cephalexin	Enrofloxacin	C/S should guide treatment.
Meningitis		Chloramphenicol *or* Doxycycline	Trimethoprim-Sulfa	Add metronidazole if anaerobic component suspected.

Ocular Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial Conjunctivitis	• *Chlamydophila* spp. • *Corynebacterium* spp. • *Mycoplasma* spp.	Doxycycline		May need to be used in conjunction with an antiviral agent (e.g. famciclovir) esp. in cats.
Corneal Ulcer	• *Pseudomonas aeruginosa* • *Streptococcus canis* • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi)*	Neomycin-Polymyxin-Bacitracin		Topical treatment.

Orthopedic Infections (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Osteomyelitis	• *Enterococcus* spp.	Clindamycin	Enrofloxacin *or* Amikacin	C/S should guide treatment; if possible, withhold treatment until results return; use in conjunction with surgical debridement.
Septic Arthritis	• ***Streptococcus pyogenes*** • ***Staphylococcus aureus*** • *Pasteurella* spp. • *Klebsiella* spp. • *Escherichia coli* • *Chlamydophila* spp. • ***Borrelia burgdorferi***	Amoxicillin-Clavulanic Acid *or* Cephalexin	Doxycycline (see note)	C/S should guide treatment; doxycycline recommended for suspected vector-borne bacterial polyarthritis.

Prophylaxis (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Clean Surgery		(Not indicated)		
Contaminated or Colorectal Surgery		(Cefazolin *or* Ampicillin-Sulbactam) ± Metronidazole		

Respiratory Tract Diseases – Lower Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial pneumonia (incl. aspiration)	• *Escherichia coli* • *Streptococcus canis* • *Pasteurella multocida* • *Pseudomonas aeruginosa* • *Staphylococcus aureus* • *Streptococcus equi sub zooepidemicus* • *Bordetella bronchiseptica*	Ampicillin *or* Ampicillin-Sulbactam	(Enrofloxacin *or* Pradofloxacin) + Clindamycin	Clindamycin not an appropriate choice if there is a suspected anaerobic component. If Enterobacterales (e.g. *E. coli, Enterobacter* spp, *Proteus* spp, *Klebsiella* spp are suspected use the alternative treatment while waiting for culture results.
Bacterial Pneumonia – suspected *Mycoplasma*		Doxycycline *or* Azithromycin	Oxytetracycline	
Pyothorax	• *Fusobacterium* spp. • *Escherichia coli* • *Nocardia* spp. • *Bacteroides* spp. • *Actinomyces viscosus* • *Streptococcus* spp. • *Staphylococcus* spp. • *Clostridium* spp. • *Mycoplasma* spp. • *Klebsiella* spp. • *Pasteurella* spp. • *Streptococcus* spp.	Ampicillin-Sulbactam ± Fluoroquinolone	Ampicillin *or* Clindamycin	Drainage ± lavage recommended in combination with antimicrobial therapy.
Tracheobronchitis	• *Bordetella bronchiseptica* • *Streptococcus equi sub zooepidemicus* • *Pseudomonas* spp.	Not Indicated	Amoxicillin-Clavulanic Acid *or* Doxycycline	Infectious canine tracheobronchitis is more often associated with viral agents than bacteria; antimicrobial therapy is indicated for cases with culture-confirmed secondary bacterial infection.

Respiratory Tract Diseases – Upper Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Feline Upper Respiratory Tract Disease	• Usually viral • *Chlamydia* spp. • *Bordetella* spp.	Doxycycline	Amoxicillin-Clavulanic Acid	
Rhinitis or Sinusitis	• *Bordetella bronchiseptica* • *Mycoplasma* spp.	Not indicated if primary rhinitis/ sinusitis	Doxycycline or Amoxicillin-Clavulanic Acid for secondary rhinitis/sinusitis	C/S is of limited use because of commensal nasopharyngeal flora.

Skin and Ear Infections (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Otitis Externa	• *Pseudomonas aeruginosa* • *Staphylococcus* spp. (*aureus, pseudintermedius)* • *Pasteurella* spp. • *Escherichia coli* • *Klebsiella* spp. • *Corynebacterium* spp. • *Proteus* spp.	(see note)		Topical treatment recommended over systemic treatment except in cases of chronic or recurrent infection; initially choose cephalexin *or* enrofloxacin based on ear cytology.
Otitis Media/ Interna	• *Pseudomonas aeruginosa* • *Staphylococcus* spp. (*aureus, pseudintermedius)* • *Pasteurella* spp. • *Escherichia coli* • *Klebsiella* spp. • *Corynebacterium* spp. • *Proteus* spp.	(see note)		Topical or surgical treatment often recommended over systemic treatment; in cases where systemic treatment is warranted, initially choose cephalexin *or* enrofloxacin based on ear cytology.
Pyoderma (surface; e.g. fold pyoderma)	• *Staphylococcus* spp. *(aureus, pseudintermedius)* • *Pseudomonas* spp.	Not Indicated (see note)		Topical treatment is sufficient.
Pyoderma (superficial; e.g. folliculitis)	• *Staphylococcus* spp. (*pseudintermedius, schleiferi, aureus, coagulans)* • *Pseudomonas aeruginosa* • *Pasteurella* spp.	Cephalexin *or* Clindamycin *or* Amoxicillin-Clavulanic Acid	Empirical, unless recurrent then choose based on culture/ susceptibility	
Pyoderma (deep; e.g. furunculosis)	• *Staphylococcus* spp. *(aureus, pseudintermedius, schleiferi, coagulans)* • *Pasteurella* spp. • *Pseudomona* spp.	Cephalexin *or* Clindamycin	Choose based on culture/ susceptibility	C/S should guide treatment; enrofloxacin is an acceptable empiric choice when there is high index of suspicion for *Pseudomonas aeruginosa* (e.g. groomer-associated deep pyoderma).

Urogenital Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Leptospirosis (suspected or confirmed)		Doxycycline		
Lower Urinary Tract Infection	• *Escherichia coli* • *Klebsiella* spp. • *Proteus* spp. • *Enterococcus* spp. • *Enterobacter* spp. • *Pseudomonas aeruginosa* • *Streptococcus* spp.	Amoxicillin	Trimethoprim-Sulfa	Enrofloxacin or pradofloxacin are suitable therapeutic options where there is documented resistance to amoxicillin or trimethoprim-sulfa (or contraindication to use of sulfa drugs).
Mastitis	• *Escherichia coli* • *Staphylocccus* spp. • *Streptococcus* spp.	Amoxicillin-Clavulanic Acid	Chloramphenicol	Chloramphenicol should only be used if it is possible to wean puppies/ kittens from the mother.
Prostatitis	• *Escherichia coli*	Enrofloxacin	Trimethoprim-Sulfa	
Pyelonephritis (Upper Urinary Tract Infection)	• *Escherichia coli* • *Leptospira* spp. • *Staphylococcus* spp. • *Enterococcus* spp. • *Streptococcus* spp.	Cefpodoxime or Enrofloxacin	Cefotaxime or Ceftazidime	
Pyometra	• *Escherichia coli* • *Streptococcus canis*	Amoxicillin-Clavulanic Acid + Enrofloxacin	Amoxicillin-Clavulanic Acid + Aminoglycoside	Ideally used in conjunction with ovario-hysterectomy surgery; also applicable to metritis.
Struvite Urolithiasis	• *Staphylococcus* spp. • *Proteus* spp.	Amoxicillin-Clavulanic Acid	Trimethoprim-Sulfa	

Wounds and Abscesses (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Dog Bite or Traumatic Wound (new)	• *Pasteurella* spp. • *Streptococcus* spp. • *Staphylococcus* spp • *Corynebacterium* spp. • *Fusobacterium* spp. • *Bacteroides* spp. • *Actinomyces* spp.	Amoxicillin-Clavulanic Acid	Amoxicillin-Clavulanic Acid + Aminoglycoside	
Dog Bite or Traumatic Wound (previously treated)		(See note)		Prior treatment increases likelihood of resistance; C/S should guide treatment.
Feline Bite Wound/Abscess	• *Pasteurella multocida* • *Streptococcus* spp. • *Corynebacterium* spp. • *Enterococcus* spp • *Porphyromonas* spp.	Amoxicillin-Clavulanic Acid	Pradofloxacin (cats only)	
Surgical Site Infection		Cephalexin *or* Clindamycin		C/S should guide treatment.

SUGGESTED TREATMENT OPTIONS BY CONDITION [EQUINE]

Quick Links

(C/S = culture and susceptibility testing)

Cardiovascular Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial endocarditis	• *Pasteurella* spp. • *Actinobacillus* spp. • *Streptococcus* spp.	Penicillin + (Gentamicin *or* Enrofloxacin)	Rifampin + antibiotic chosen based on C/S	

Central Nervous System Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Intracranial abscess	• *Streptococcus equi equi*	Penicillin ± Trimethoprim-sulfa	Chloramphenicol	Antibiotic therapy should be used in combination with surgical debridement
Meningitis	• *Mannheimia haemolytica* • *Actinomyces* spp. • *Klebsiella* spp. • *Streptococcus* spp.	Chloramphenicol *or* Trimethoprim-sulfa	Ceftriaxone	
Tetanus	• *Clostridium tetani*	Metronidazole *or* Penicillin		Broad-spectrum therapy is indicated in cases of suspected aspiration pneumonia secondary to tetanus

Gastrointestinal Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial cholangiohepatitis	• *Salmonella* spp. • *Escherichia coli* • *Pseudomonas* spp. • *Actinobacillus equuli* • *Clostridium* spp. • *Pasteurella* spp. • *Streptococcus* spp.	Penicillin + Gentamicin	Trimethoprim-sulfa	Submit biopsy for C/S
Choke – prophylaxis against pneumonia	• *Streptococcus zooepidemicus* • *Rhodococcus equi*	Trimethoprim-sulfa ± Metronidazole	Penicillin + Gentamicin	
Diarrhea – acute	• *Salmonella* spp. • *Clostridium* spp. • *Neorickettsia risticii* • *Aeromonas* spp. • *Lawsonia intracellularis* • *Escherichia coli* • *Actinobacillus* spp.	Antibiotic selection based on most likely differential diagnosis (e.g. oxytetracycline for PHF, metronidazole for clostridial diarrhea)	Penicillin + Gentamicin ± Metronidazole	C/S indicated to confirm diagnosis and further guide antimicrobial selection
Diarrhea – chronic (>1mo duration)		(See note)		C/S indicated prior to choosing treatment
Peritonitis – primary	• *Actinobacillus equuli* • *Escherichia coli* • *Staphylococcus* spp. • *Streptococcus* spp. • *Bacteroides fragilis, Clostridium* spp.	Penicillin ± Gentamicin	Trimethoprim-sulfa	*Actinobacillus equuli* is the most common causative agent; confirm with C/S

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Peritonitis – secondary	• *Rhodococcus equi* mixed infections common	Penicillin + (Gentamicin *or* Enrofloxacin) + Metronidazole	Chloramphenicol	Substitute amikacin for gentamicin in foals; a macrolide + rifampin can be appropriate in older foals with *R. equi* peritonitis

Hoof and Skin Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Cellulitis	• *Staphylococcus aureus* • *Streptococcus* spp.	Trimethoprim-sulfa *or (*Penicillin + Gentamicin*)*	Oxytetracycline *or* Doxycycline	Use of regional limb perfusion or antibiotic impregnated beads, typically containing aminoglycosides, are also recommended
Pyoderma	• *Staphylococcus aureus* • *Staphylococcus intermedius* • *Corynebacterium pseudotuberculosis*	Trimethoprim-sulfa	Oxytetracycline *or* Doxycycline	
Subsolar abscess		Not indicated	Oxytetracycline *or* Doxycycline	
Subsolar abscess – with P3 involvement		Oxytetracycline *or* Doxycycline	Penicillin + Gentamicin + Metronidazole	

Muscle, Bone, and Joint Infections (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Clostridial myositis		Metronidazole + Penicillin		
Internal abscesses		Penicillin + Rifampin	Trimethoprim-sulfa + Rifampin	Addition of rifampin to penicillin enables penicillin to more easily enter abscesses
Septic arthritis/ osteomyelitis	• *Streptococcus zooepidemicus* • *Escherichia coli* • *Actinobacillus* spp. • *Staphylococcus* spp. • *Salmonella* spp.	Chloramphenicol	Penicillin + Gentamicin ± Metronidazole	Systemic therapy in combination with intra-articular injections or implantation of antibiotic impregnated beads is also recommended

Neonatal Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Meningitis	• *Actinobacillus equuli* • *Rhodococcus equi* • *Streptococcus* spp. • *Staphylocccus* spp.	Cefotaxime or Chloramphenicol	Ampicillin + Amikacin	
Omphalitis (umbilical infection)	• *Escherichia coli* • *Streptococcus zooepidemicus*	Trimethoprim-sulfa *or* (Penicillin + Gentamicin)	Cefpodoxime	
Patent urachus	• *Escherichia coli* • *Streptococcus* spp. • *Staphyloccus* spp.	Trimethoprim-sulfa *or* (Penicillin + Gentamicin)	Cefpodoxime	
Pneumonia – non-*Rhodococcus equi*	• *Streptococcus zooepidemicus* • *Streptococcus equi* • *Actinobacillus* spp. • *Pseudomonas aeruginosa*	Penicillin *or* Ceftiofur	Penicillin + Gentamicin	
Pneumonia	• *Rhodococcus equi*	Clarithromycin + Rifampin	Doxycycline + Rifampin	Erythromycin or azithromycin can be substituted for clarithromycin
Septic arthritis	• *Streptococcus zooepidemicus* • *Escherichia coli* • *Actinobacillus* spp. • *Salmonella* spp.	Penicillin + Amikacin ± Metronidazole	Oxytetracycline	Obtain blood C/S to guide treatment

Sepsis	• *Rhodococcus equi* • *Streptococcus* spp. • *Salmonella* spp. • *Escherichia coli* • *Actinobacillus* spp. • *Klebsiella* spp. • *Enterobacter* spp. • *Pseudomonas* spp. • *Clostridium* spp.	(Penicillin *or* Ampicillin) + Amikacin ± Metronidazole	Cefotaxime *or* Ceftazidime *or* Ceftriaxone	If sepsis is secondary to *Rhodococcus equi* pneumonia, treat as described above for pneumonia

Ocular Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Corneal ulceration	• *Streptococcus zooepidemicus* • *Pseudomonas aeruginosa*	Neomycin-Polymyxin B-Bacitracin	Ofloxacin	Used as a topical treatment; C/S recommended
Corneal ulceration – w/ melting	• *Pseudomonas aeruginosa* • *Staphylococcus* spp. • *Streptococcus* spp.	Levofloxacin	Chloramphenicol	Used as a topical treatment; antibiotic to be given in combination with an antifungal (e.g. voriconazole); C/S recommended

Prophylaxis (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Clean Surgery		Penicillin		
Contaminated Surgery		Penicillin + Gentamicin		
High-risk surgery		Penicillin + Gentamicin		

Respiratory Tract Diseases – Lower Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Pleuropneumonia	• *Streptococcus equi zooepidemicus* • *Escherichia coli* • *Actinobacillus* spp. • *Klebsiella* spp. • *Enterobacter* spp. • *Staphylococcus aureus* • *Pasteurella* spp. • *Bacteroides* spp. • *Clostridium* spp.	Penicillin + Gentamicin ± Metronidazole	Chloramphenicol	
Pneumonia	• *Streptococcus equi zooepidemicus* • *Escherichia coli* • *Actinobacillus* spp. • *Klebsiella* spp. • *Enterobacter* spp. • *Staphylococcus aureus* • *Pasteurella* spp. • *Bacteroides* spp. • *Clostridium* spp.	(Penicillin + Gentamicin) *or* Ceftiofur	Penicillin + (Gentamicin *or* Enrofloxacin)	C/S recommended to guide therapy, particularly in cases of bronchopneumonia; ampicillin can be substituted for penicillin
Pneumonia	• *Rhodococcus equi*	Clarithromycin + Rifampin	Doxycycline + Rifampin	Substitute clarithromycin for gentamicin in foals

Respiratory Tract Diseases – Upper Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Guttural pouch empyema	• *Streptococcus equi* • *Streptococcus zooepidemicus*	Penicillin	Oxytetracycline *or* Doxycycline	
Primary sinusitis	• *Streptococcus* spp.	Penicillin	Trimethoprim-sulfa	Antibiotics should be used in conjunction with lavage to remove purulent material
Strangles	• *Streptococcus equi* subsp. *Equi*	Penicillin	Trimethoprim-sulfa	Horses in the early stages of disease (pre-lymphadenopathy and abscessation) are the most likely to benefit from antimicrobials, but antibiotic treatment can prevent development of protective immunity

Urogenital Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Cystitis	• *Escherichia coli* • *Streptococcus* spp. • *Enterococcus* spp. • *Staphylococcus* spp.	Trimethoprim-sulfa	Penicillin + Gentamicin	Sulfadiazene retains more activity after urinary excretion than sulfamethoxazole
Leptospirosis	• *Leptospira* spp.	Penicillin	Oxytetracycline	
Mastitis	• *Streptococcus zooepidemicus* • Other *Streptococcus* spp.	Trimethoprim-sulfa	Penicillin ± aminoglycoside antibiotic	C/S recommended to guide antimicrobial choice; cattle intramammary infusion products may be used off-label until selection of a systemic antibiotic can be made
Metritis	• *Streptococcus zooepidemicus* • *Escherichia coli* • *Pseudomonas aeruginosa* • *Klebsiella pneumonia* • *Taylorella equigenitalis*	Penicillin + (Amikacin *or* Gentamicin) ± Metronidazole	Penicillin + Gentamicin	Given as a uterine lavage for endometritis
Pyelonephritis	• *Escherichia coli* • *Streptococcus zooepidemicus* • *Staphylococcus aureus* • *Corynebacterium* spp.	Trimethoprim-sulfa	Penicillin	Sulfadiazine retains more activity after urinary excretion than sulfamethoxazole

Wounds (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Contaminated – non-complicated		Not indicated	Trimethoprim-sulfa	
Contaminated – on limbs		Trimethoprim-sulfa	Oxytetracycline *or* Doxycycline	
Contaminated – w/ open fracture		Penicillin + Gentamicin + Metronidazole		
Contaminated – w/ synovial involvement		Penicillin + Gentamicin	Oxytetracycline + Metronidazole	

SUGGESTED TREATMENT OPTIONS BY CONDITION [FARM ANIMAL]

Quick Links

(C/S = culture and susceptibility testing)

Central Nervous System Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial meningitis	• *Listeria monocytogenes* • *Escherichia coli* • *Streptococcus spp.* • *Histophilus spp.*	Ceftiofur (ELDU)	Penicillin *or* Ampicillin (ELDU)	
Listeriosis		Penicillin (ELDU) or Oxytetracycline (ELDU)	Oxytetracycline (ELDU) or Penicillin (ELDU)	Duration of therapy may need to be up to 1-2 weeks.
Nervous coccidiosis		Amprolium	Sulfadimethoxine (ELDU)	
Otitis media/interna		Florfenicol (ELDU; see note)	Macrolide antibiotic (ELDU)	C/S recommended due to the likelihood of mycoplasmal involvement, warranting use of florfenicol.
Thromboembolic meningoencephalitis	• *Histophilus somni*	Oxytetracycline (ELDU)	Florfenicol (ELDU)	

Gastrointestinal Diseases and Hepatobiliary Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Traumatic reticuloperitonitis (hardware disease)	• Control of secondary bacterial infection (mixed)	Oxytetracycline or Penicillin (ELDU)	Ceftiofur (ELDU)	Antimicrobial treatment unrewarding, but may allow short-term survival to calving; use in combination with drainage and lavage.
Wooden Tongue	• *Actinobacillosis lignieresii*	Sodium Iodide (ELDU) *and* Isoniazid (ELDU)	Penicillin *and* Isoniazid (ELDU) *or* Oxytetracycline *and* Isoniazid (ELDU)	
Lumpy Jaw	• *Actinomyces bovis*	Sodium Iodide (ELDU) *and* Isoniazid (ELDU)	Penicillin *and* Isoniazid (ELDU) *or* Oxytetracycline *and* Isoniazid (ELDU)	
Coccidiosis		Amprolium	Sulfadimethoxine (ELDU)	
Colibacillosis – swine	• *Escherichia coli*	Ampicillin	Oxytetracycline *or* Enrofloxacin	
Enterotoxemia (“overeating disease”)	• *Clostridium perfringens*	Penicillin *or* Ampicillin (ELDU)		
Johne’s Disease	• *Mycobacterium avium* subsp. *paratuberculosis*	Not recommended (see note)		Antimicrobial treatment likely to be unsuccessful due to recurrent nature of disease; generally not treated
Peritonitis	• *Salmonella enterica* • *Escherichia coli* • *Clostridium perfringens* • *Mycobacterium spp.* • *Brachyspira hyodysenteriae* • *Lawsonia intracellularis*	Ceftiofur (ELDU)	Oxytetracycline *or* Florfenicol (ELDU)	
Salmonellosis		Ceftiofur	Florfenicol (ELDU)	

Musculoskeletal, Skin, and Lymphatic Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Blackleg	• *Clostridium chauvoei*	Penicillin		Also relevant to treatment of other clostridial diseases (e.g. malignant edema, black disease, tetanus, bacillary hemoglobinuria).
Caseous Lymphadenitis	• *Corynebacterium pseudotuberculosis*	Not recommended (see note)		Antimicrobial treatment likely to be unsuccessful due to recurrent nature of disease; not generally treated
Dermatophilosis	• *Dermatophilus congolensis*	Penicillin (ELDU)	Oxytetracycline (ELDU)	
Erysipelas ("diamond skin disease")	• *Erysipelothrix rhusiopathiae*	Penicillin *or* Tylosin		
Infectious arthritis – swine	• *Streptococcus suis* • *Erysipelothrix rhusiopathiae* • *Escherichia coli* • *Salmonella enterica* • *Haemophilus parasuis* • *Actinobacillus suis* • *Mycoplasma hyosynoviae*	Tylosin		
Interdigital necrobacillosis (foot rot)	• *Fusobacterium necrophorum*	Ceftiofur *or* Oxytetracycline *or* Sulfadimethoxine *or* Tulathromycin, etc.		Product indications for specific organisms are variable; consult specific label prior to use.
Subsolar abscesses		(see note)		Antimicrobial treatment not indicated.
Wounds		Oxytetracycline	Florfenicol (ELDU)	

Neonatal Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bacterial meningitis	• *Listeria monocytogenes* • *Escherichia coli* • *Streptococcus spp.* • *Histophilus spp.*	Ceftiofur (ELDU)	Penicillin *or* Ampicillin (ELDU)	C/S recommended.
Bronchopneumonia	• *Mannheimia haemolytica* • *Pasteurella multocida* • *Histophilus somni* • *Mycoplasma hyopneumoniae*	Ceftiofur	Enrofloxacin *or* Florfenicol	Product indications for specific organisms are variable; consult specific label prior to use.
Diarrhea (scours)	• Escherichia coli • Salmonella spp. • Clostridium perfringens	Oxytetracycline	Ceftiofur (ELDU)	
Omphalophlebitis		Penicillin (ELDU)		To be used in combination with local drainage and topical treatment.
Sepsis	• *Streptococcus* spp. • *Staphylococcus* spp. • *Escherichia coli,* • ***Haemophilus influenzae*** • *Listeria monocytogenes*	Ceftiofur ± Ampicillin (ELDU)		C/S recommended.
Septic arthritis	• *Staphylococcus* spp. • *Streptococcus* spp. • coliforms	Penicillin *or* Ampicillin (ELDU)	Oxytetracycline (ELDU)	C/S recommended.

Ocular Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Infectious keratoconjunctivitis (pinkeye)	• *Moraxella bovis*	Oxytetracycline + Polymyxin B (topical)	Tulathromycin	Other topical treatments (e.g. neomycin-polymyxin B-bacitracin) may also be considered.

Respiratory Tract Diseases – Lower Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Bronchopneumonia – cattle	• *Mannheimia haemolytica* • *Pasteurella multocida* • *Histophilus somni*	Ceftiofur	Enrofloxacin *or* Florfenicol	Product indications for specific organisms are variable; consult specific label prior to use.
Bronchopneumonia – swine	• *Actinobacillus pleuropneumoniae* • *Bordetella bronchiseptica* • *Pasteurella multocida*	Ceftiofur	Enrofloxacin	Product indications for specific organisms are variable; consult specific label prior to use.

Respiratory Tract Diseases – Upper Respiratory Tract (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Necrotic laryngitis (calf diphtheria)	• *Fusobacterium necrophorum*	Oxytetracycline *or* Penicillin	Penicillin *or* Ampicillin *or* Ceftiofur (ELDU)	
Pharyngeal or laryngeal abscess		Penicillin	Oxytetracycline	Should be used in combination with lancing/ flushing.
Sinusitis	• *Actinomyces pyogenes* • *Pasteurella multocida*	Penicillin	Oxytetracycline	Treatment only indicated in presence of clinical signs.

Urogenital Diseases (Back to Reference) ↩

Condition	Targeted Organisms	First Line	Alternative Treatment	Notes
Cystitis	• *Corynebacterium* spp. • *Escherichia coli*	Ceftiofur *or* Ampicillin (ELDU)	Oxytetracycline (ELDU)	
Leptospirosis		Oxytetracycline	Ceftiofur (ELDU)	
Mastitis	• *Staphylococcus aureus* • *Pseudomonas aeruginosa* • *Staphylococcus epidermidis* • *Streptococcus agalactiae* • *Streptococcus uberis* • *Brucella melitensis* • *Corynebacterium bovis* • *Mycoplasma* spp.	Cephapirin	Amoxicillin	Given intramammary; parenteral penicillin indicated if there are systemic clinical signs.
Metritis – camelid	• *Escherichia coli* • *Streptococcus equi* subspecies *zooepidemicus*	Penicillin (ELDU)	Ceftiofur (ELDU)	Given as an intrauterine infusion.
Metritis – cattle and small ruminants	• *Campylobacter* spp. • *Leptospira* spp. • *Trueperella pyogenes* • *Fusobacterium necrophorum*	Penicillin (ELDU)	Ceftiofur (ELDU)	Given parenterally; intrauterine infusions of penicillin or oxytetracycline have also been used, but efficacy is questionable.
Posthitis / vulvitis	• *Corynebacterium renale*	Oxytetracycline (ELDU)	Penicillin *or* Ceftiofur (ELDU)	To be used in combination with topical treatment and dietary changes.
Pyelonephritis	• *Corynebacterium renale* • *Trueperella pyogenes* • *Escherichia coli*	(see note)		Culture/susceptibility recommended; penicillin (ELDU) for treatment of *C. renale* or *T. pyogenes*, or ceftiofur (ELDU) for treatment of *E. coli*.

BACTERIAL INTRINSIC RESISTANCE

Organism	Antimicrobial Agent	Main clinical presentation	Additional comments
Gram-positive bacteria	Aztreonam, Polymyxin, temocillin, Polymyxin B/colistin, nalidixic acid		
Enterobacteriales spp.[1]	Clindamycin, daptomycin, fusidic acid, glycopeptides (vancomycin, teicoplanin), lipoglycopeptides (oritavancin, telavancin), linezolid, tedizolid, quinupristin-dalfopristin, rifampin, and macrocodes (erythromycin, clarithromycin, & azithromycin)		There are some exceptions with macrolides (i.e. *Salmonella* & *Shigella* app. with azithromycin)
***Klebsiella aerogenes* and *Enterobacter cloacae* complex**	Ampicillin, Amoxicillin, Amoxicillin-clavulanic, Ampicillin-sulbactam, cephalosporins	Small animal UTI	
***Klebsiella* spp**	Ampicillin, Ticarcillin	Small animal UTI Wound infections	
Proteus mirabilis	Tetracycline, Nitrofurantoin, Polymyxin B, Colistin	Small animal UTI Canine otitis Canine otitis	
Yersinia enterocolitica	Ampicillin, Amoxicillin-clavulanic, Ampicillin-sulbactam, Ticarcillin, Cephalosporins	Carrier state in many animal species	**Zoonosis** Important in human gastroenteritis (food poisoning)
Pseudomonas aeruginosa	Most beta-lactams, Ertapenem, Tetracyclines, Sulfas, Trimethoprim, Trimethoprim-sulfamethoxazolazole, Chloramphenicol; Clindamycin, Fusidic acid; Glycopeptides; Linezolid, Macrolides and Rifampin	Canine otitis Small animal UTIs Wound infections, etc.	Keep in mind that *P. aeruginosa* is an environmental bacterium; ponder its clinical significance when isolated from a body site

1. Enterobacteriales species are not recognized as intrinsically resistant to ampicillin, amoxicillin, and their respective combinations. However, in companion animals administration of these drugs to treat infections outside of the lower urinary tract may not achieve therapeutic levels. Therefore, use of these drugs to treat Enterobacteriales species should be reserved for lower urinary tract infections only.

Organism	Antimicrobial Agent	Main clinical presentation	Additional comments
Methicillin-resistant *Staphylococcus aureus* and coagulase-negative *staphylococci* (methicillin-resistant *staphylococci* [MRS])	Beta-lactam agents, ie, penicillins, beta-lactam/beta-lactamase inhibitor combinations, cephems (with the exception of the cephalosporins with anti-MRSA [methicillin-resistant *S. aureus*] activity), and carbapenems	Abscesses Suppurative conditions Dermatitis Systemic infections Mastitis	This is because most cases of documented MRS infections have responded poorly to b-lactam therapy, or because convincing clinical data that document clinical efficacy for those agents have not been presented.
Enterococcus faecalis* & *E. faecium	Cephalosporins, Aminoglycosides, Clindamycin, Trimethoprim, Trimethoprim- sulfamethoxazolazole	Wound infections Cattle: mastitis Small animals: UTIs Canine otitis	Other *Enterococcus* spp are also resistant to Vancomycin. It is important to monitor and report Vancomycon resistant *Enterococcus*
Campylobacter fetus	Fusidic acid; Streptogramins; Trimethoprim; Nalidixic Acid	Bovine: epizootic bovine infertility (C. fetus subsp venerealis) Sheep, cattle: abortions	
Campylobacter jejuni subsp. jejuni, Campylobacter coli	Fusidic acid; Streptogramins; Trimethoprim	Sheep: abortions (Campylobacter jejuni subsp. Jejuni) Enteritis Diarrhea	Recently an increased resistance against fluoroquinolones and macrolides is reported in campylobacter isolated from humans and animals
***Clostridium* spp**	Aminoglycosides		
***Bacteroides* spp**	Aminoglycosides; Penicillin; Ampicillin		Anaerobic

Adapted from: M100 Performance Standards for Antimicrobial Susceptibility Testing, Clinical and Laboratory Standard Institute

BACTERIAL ORGANISMS BY MORPHOLOGY/ OXYGEN REQUIREMENT [COMPANION]

	Aerobes/Facultatives	Anaerobes
Gram-Positive	**Cocci** • *Streptococcus canis* (often in chains) • *Staphylococcus* spp. • *Enterococcus* spp. **Filamentous, branching rods** • *Nocardia* spp. **Bacilli** • *Corynebacterium* spp. • *Listeria* spp. • *Mycobacterium*	**Bacilli** • *Clostridium* spp. (incl. *difficile* and *perfringens)* **Filamentous, branching rods** • *Actinomyces* spp.
Gram-Negative	**Bacilli** (enteric spp.) • *Escherichia coli* • *Proteus* spp. • *Salmonella enterica*, and other spp. • *Klebsiella* spp. • Other *Enterobacteriaceae* • *Campylobacter jejuni* ("seagull wing" appearance) **Bacilli** (non-enteric spp.) • *Pseudomonas aeruginosa* • *Pasteurella* spp. • *Bordetella bronchiseptica* • *Brucella canis* (short rods to cocci)	**Bacilli (enteric spp)** • *Bacteroides* spp. **Bacilli (non-enteric spp)** • *Prevotella* spp. • *Porphiromonas* spp. **Cocci** • *Anaplasma* spp. • *Ehrlichia* spp. • *Neorickettsia* spp.

- **Intracellular:** *Chlamydophila spp. (*G- but difficult to Gram stain*), Anaplasmataceae family (Anaplasma, Ehrlichia, Neorickettsia)*
- **Spirochetes:** *Leptospira* spp., *Borrelia burgdorferi*

- **Acid fast**: *Mycobacterium* spp., *Nocardia* spp.
- **Lack a Cell Wall**: *Mycoplasma* spp. (can be intracellular or extracellular)

BACTERIAL ORGANISMS BY MORPHOLOGY/ OXYGEN REQUIREMENT [EQUINE]

	Aerobes/Facultatives	Anaerobes
Gram-Positive	**Cocci** • *Streptococcus* spp. (often in chains) • *Staphylococcus* spp. • *Enterococcus* spp. • *Dematophilus congolensis* ("railroad tracks")	**Bacilli** • *Clostridium* spp. (incl. *botulinum, tetani, difficile*, and *perfringens)* • *Actinomyces bovis*
	Filamentous, branching rods • *Actinomyces* spp. (may also be anaerobic)	
	Coccobacilli • *Rhodococcus equi* • *Corynebacterium* spp. ("diptheroid" appearance)	
Gram-Negative	**Bacilli (enteric spp.)** • *Escherichia coli* • *Proteus* spp. • *Salmonella* spp. • *Lawsonia intracellularis*	**Bacilli** • *Fusobacterium* spp. • *Bacteroides fragilis*
	Bacilli (non-enteric spp.) • *Actinobacillus* spp. • *Pasteurella caballi* • *Pseudomonas* spp. • *Brucella abortus* • *Burkholderia mallei* • *Taylorella equigenitalis*	

- **Intracellular:** *Neorickettsia* spp., *Anaplasma* spp.
- **Spirochetes:** *Leptospira* spp. (G-), *Borrelia burgdorferi* (G-)

- **Acid fast**: *Mycobacterium* spp.

BACTERIAL ORGANISMS BY MORPHOLOGY/ OXYGEN REQUIREMENT [FARM ANIMAL]

	Aerobes/Facultatives	Anaerobes
Gram-Positive	**Cocci** • *Dematophilus congolensis* (“railroad tracks”) • *Staphylococcus* spp. • *Streptococcus* spp. **Coccobacilli** • *Trueperella pyogenes* **Bacilli** • *Bacillus anthracis* (regulatory disease) • *Corynebacterium* spp. (curved rods) • *Erysipelothrix rhusiopathia* • *Listeria monocytogenes* **Filamentous, branching rods** • *Actinomyces* spp. • *Nocardia* spp.	**Bacilli** • *Actinomyces bovis* • *Clostridium* spp. (incl. *botulinum, tetani, difficile*, and *perfringens)*
Gram-Negative	**Bacilli (enteric spp.)** • *Campylobacter* spp. (curved rod) • *Escherichia coli* • *Lawsonia intracellularis* • *Salmonella* spp. **Bacilli (non-enteric spp.)** • *Actinobacillus* spp. • *Bordetella* spp. • *Haemophilus* spp. • *Histophilus* spp. • *Mannheimia* spp. • *Pasteurella* spp. • *Proteus* spp. • *Pseudomonas* spp. **Coccobacilli** • *Brucella* spp. • *Moraxella* spp.	**Bacilli** • *Dichelobacter nodosus* • *Bacteroides* spp. • *Fusobacterium necrophorum*

- ***Lack a Cell Wall*:** *Mycoplasma* spp.
- **Spirochetes:** *Leptospira* spp. (G-), *Brachyspira* spp. (G-)
- **Acid fast**: *Mycobacterium* spp.

BACTERIAL ORGANISMS BY SITE: CATS [COMPANION]

(= most common differential diagnoses; this is NOT an exhaustive list)*

Site	Bacterial Organisms
Bacteremia	• *Streptococcus canis** • *Staphylococcus* spp. (*aureus, pseudintermedius, schleiferi*)* • Enterics (esp. *Escherichia coli*)* • *Enterococcus* spp.*
Cornea	• *Chlamydophila felis* • *Mycoplasma* spp. • *Pseudomonas aeruginosa* • *Staphylococcus* spp. (*aureus, pseudintermedius, schleiferi*)
Draining Tracts/Wounds	• *Staphylococcus* spp. (*aureus, pseudintermedius, schleiferi*)* • *Pseudomonas aeruginosa** • *Pasteurella multocida** • *Actinomyces* spp.* • *Nocardia* spp.* • Enterics* • *Streptococcus canis** • Anaerobes
Ears	• *Staphylococcus* spp. (*aureus, pseudintermedius*) • *Pasteurella* spp. • *Klebsiella*
Gastrointestinal	• *Campylobacter jejuni** • *Salmonella enterica**
Integument	• *Staphylococcus* spp. (*aureus, pseudintermedius, schleiferi, coagulans*)* • *Pseudomonas aeruginosa**
Peritonitis	• Enterics* • Anaerobes* • *Enterococcus* spp.*
Pyothorax	• *Streptococcus canis** • *Pasteurella multocida** • *Actinomyces* spp.* • *Nocardia* spp.* • Anaerobes*
Reproductive Tract	• *Escherichia coli** • *Streptococcus canis**

Site	Bacterial Organisms
Respiratory Tract	• *Streptococcus canis** • *Mycoplasma* spp.* • Pasteurella *multocida** • *Pseudomonas* spp. • *Bordetella bronchiseptica* • Enterics • *Chlamydophila felis*
Urinary Tract	• *Escherichia coli** • *Proteus* spp.* • Other Enterics* • *Enterococcus* spp.* • *Staphylococcus* spp. (*aureus, pseudintermedius, schleiferi*)

BACTERIAL ORGANISMS BY SITE: DOGS [COMPANION]

(= most common differential diagnoses; this is NOT an exhaustive list)*

Site	Bacterial Organisms
Bacteremia	• *Streptococcus canis** • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)* • Enterics (esp. *Escherichia coli*)* • *Enterococcus* spp.*
Cornea	• *Pseudomonas aeruginosa** • *Streptococcus canis** • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)*
Draining Tracts/Wounds	• *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)* • *Pseudomonas aeruginosa** • *Actinomyces* spp.* • *Nocardia* spp.* • Enterics* • *Streptococcus canis** • Anaerobes* • *Mycobacteria* spp.*
Ears	• *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)* • *Corynebacterium* spp. • *Proteus* spp.*
Gastrointestinal	• *Campylobacter jejuni** • *Salmonella enterica** • *Clostridium difficile* or *perfringens**
Integument	• *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi, coagulans*)* • *Pseudomonas aeruginosa**
Peritonitis	• Enterics* • Anaerobes* • *Enterococcus* spp.*
Pyothorax	• *Streptococcus canis** • *Pasteurella* spp.* • *Actinomyces* spp.* • *Nocardia* spp.* • Anaerobes*

Site	Bacterial Organisms
Reproductive Tract	• *Escherichia coli** • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)* • *Brucella* canis (uncommon; regulatory disease)
Respiratory Tract	• *Bordetella bronchiseptica** • *Pasteurella* spp.* • *Mycoplasma* spp.* • *Streptococcus canis** • Enterics • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)* • *Pseudomonas* spp.
Urinary Tract	• *Escherichia coli** • *Proteus* spp.* • Other Enterics* • *Enterococcus* spp.* • *Staphylococcus* spp. (*pseudintermedius, aureus, schleiferi*)

BACTERIAL ORGANISMS BY SITE [EQUINE]

(= most common differential diagnoses)*

Site	Bacterial Organisms
Bacteremia	• *Streptococcus zooepidemicus** • *Escherichia coli* and other enteric spp.* • *Actinobacillus* spp. • *Salmonella enterica*
Eye	• *Streptococcus zooepidemicus** • *Pseudomonas aeruginosa*
Draining Tracts/Wounds	• *Staphylococcus aureus* • *Pseudomonas aeruginosa* • Enterics • *Actinomyces* spp. • Anaerobes, esp. *Clostridium* spp. • *Burkholderia mallei* (foreign animal, regulatory disease)
Gastrointestinal	• *Salmonella enterica** • *Clostridium difficile** • *Clostridium perfringens** • *Lawsonia intracellularis** • *Neorickettsia risticii**
Guttural Pouch	• *Streptococcus zooepidemicus** • *Streptococcus equi**
Integument	• *Dermatophilus congolensis** • *Corynebacterium pseudotuberculosis** • *Staphylococcus aureus**
Lymphadenopathy	• *Streptococcus equi**
Peritonitis	• *Actinobacillus equuli** • *Streptococcus zooepidemicus** • Enterics* • Anaerobes • *Enterococcus* spp.
Reproductive	• *Streptococcus zooepidemicus** • Coliforms • *Pseudomonas aeruginosa* • *Leptospira* spp. • *Taylorella equigenitalis* (uncommon; regulatory disease)

Site	Bacterial Organisms
Respiratory System	• *Streptococcus zooepidemicus** or *S. equi* • *Actinobacillus* spp.* • *Rhodococcus equi** • *Pseudomonas aeruginosa* • Coliforms
Urinary	• *Escherichia coli** • Enterics • *Streptococcus zooepidemicus* • *Corynebacterium* spp.

BACTERIAL ORGANISMS BY SITE: CAMELIDS [FARM ANIMAL]

Site	Bacterial Organisms
Bacteremia	• *Streptococcus spp.* • *Escherichia coli* • *Salmonella enterica* • *Staphylococcus* spp. (uncommon) • Miscellaneous anaerobes
Central Nervous System	• *Listeria monocytogenes* • Bacteremia pathogens
Draining Tracts/Wounds	• *Trueperella pyogenes* • *Streptococcus* spp. • *Actinomyces* spp. • *Corynebacterium pseudotuberculosis* • *Fusobacterium necrophorum*
Gastrointestinal	• *Escherichia coli* • *Salmonella enterica* • *Clostridium perfringens* • *Mycobacterium avium* subsp. *paratuberculosis*
Integument	• *Staphylococcus* spp. • *Streptococcus* spp. • *Corynebacterium pseudotuberculosis* • *Dermatophilus congolensis* • *Trueperella pyogenes*
Mastitis	• *Escherichia coli* • *Streptococcus* spp.
Reproductive Tract	• *Escherichia coli* • *Staphylococcus* spp. • *Streptococcus* spp. • *Pseudomonas aeruginosa* • *Trueperella pyogenes* • *Leptospira* spp. • *Brucella* spp. (uncommon; regulatory disease)

BACTERIAL ORGANISMS BY SITE: RUMINANTS [FARM ANIMAL]

(= most common differential diagnoses)*

Site	Bacterial Organisms
Bacteremia	• *Escherichia coli** • *Histophilus somni* • *Pasteurella spp.* • *Listeria monocytogenes* • *Salmonella enterica* • *Bacillus anthracis* (uncommon; regulatory disease)
Eye	• *Moraxella bovis** • *Moraxella bovoculi* • *Branhamella ovis*
Draining Tracts/Wounds	• *Trueperella pyogenes** • *Corynebacterium pseudotuberculosis** • *Actinomyces spp.* • *Clostridium histolyticum* • Enterics
Gastrointestinal	• *Salmonella enterica** • *Escherichia coli* (enterotoxigenic in calves) • *Clostridium perfringens* • *Mycobacterium avium subsp. paratuberculosis*
Mastitis	• *Streptococcus spp. (agalactiae, dysgalactiae, uberis)* • *Staphylococcus aureus* • Coliforms • Coagulase-negative *Staphylococcus* spp. • *Pseudomonas* spp. • *Proteus* spp. • *Trueperella pyogenes* • *Pasteurella* spp. (uncommon) • *Mycoplasma* spp. • *Klebsiella* spp.
Reproductive Tract	• *Trueperella pyogenes** • *Escherichia coli** • Anaerobes* • *Leptospira* spp. • *Mycoplasma bovigenitalium* • *Campylobacter fetus,* other *Campylobacter* spp. • *Brucella abortus* (uncommon; regulatory disease)

Site	Bacterial Organisms
Respiratory Tract	• *Pasteurella multocida** • *Mannheimia hemolytica** • *Histophilus somni** • *Mycoplasma* spp. • *Trueperella pyogenes* • *Salmonella enterica* serotype Dublin • *Fusobacterium necrophorum* (upper respiratory tract)
Traumatic Reticuloperitonitis	• *Trueperella pyogenes* • *Actinomyces* spp. • Anaerobes
Urinary Tract	• *Corynebacterium renale** • *Trueperella pyogenes** • *Escherichia coli** • *Leptospira* spp.

BACTERIAL ORGANISMS BY SITE: SWINE [FARM ANIMAL]

(= most common differential diagnoses)*

Site	Bacterial Organisms
Bacteremia	• *Streptococcus suis** • *Erysipelothrix rhusiopathiae** • *Escherichia coli* • *Salmonella enterica* • *Haemophilus parasuis* • *Actinobacillus suis*
Gastrointestinal	• *Escherichia coli (*enterotoxigenic in piglets*)** • *Salmonella enterica** • *Lawsonia intracellularis** • *Clostridium* spp. • *Brachyspira hyodysenteriae**
Integument	• *Staphylococcus hyicus** • *Erysipelothrix rhusiopathiae**
Joints	• *Streptococcus suis** • *Erysipelothrix rhusiopathiae** • *Escherichia coli* • *Salmonella enterica* • *Haemophilus parasuis* • *Actinobacillus suis* • *Mycoplasma hyosynoviae*
Polyserositis	• *Haemophilus parasuis**
Reproductive Tract	• *Brucella suis* (regulatory disease)* • *Leptospira* spp.*
Respiratory Tract	• *Actinobacillus pleuropneumoniae** • *Streptococcus suis* • *Bordetella bronchiseptica* (lower and upper respiratory tract)* • *Actinobacillus suis* • *Haemophilus parasuis* • *Mycoplasma hyopneumoniae* • *Pasteurella multocida* (upper respiratory tract)*

EXTRA-LABEL DRUG USE REQUIREMENTS [FARM ANIMAL]

Requirements for Use

- ELDU is permitted only by or under the supervision of a veterinarian.
- ELDU is allowed only for FDA approved animal and human drugs.
- A valid Veterinarian/Client/Patient Relationship is a prerequisite for all ELDU.
- ELDU for therapeutic purposes only (animal's health is suffering or threatened). Not drugs for production use.
- Rules apply to dosage form drugs and drugs administered in water. ELDU in feed is prohibited.
- ELDU is not permitted if it results in violative food residue, or any residue which may present a risk to public health.
- FDA prohibition of a specific ELDU precludes such use.

Record Requirements

- Identify the animals, either as individuals or a group.
- Animal species treated.
- Numbers of animals treated.
- Conditions being treated.
- The established name of the drug and active ingredient.
- Dosage prescribed or used.
- Duration of treatment.
- Specified withdrawal, withholding, or discard time(s), if applicable, for meat, milk, eggs, or animal-derived food.
- Keep records for 2 years.
- FDA may have access to these records to estimate risk to public health.

Label Requirements

- Name and address of the prescribing veterinarian.
- Established name of the drug.
- Any specified directions for use including the class/species or identification of the animal or herd, flock, pen, lot, or other group; the dosage frequency, and route of administration; and the duration of therapy.
- Any cautionary statements.
- Your specified withdrawal, withholding, or discard time for meat, milk, eggs, or any other food.

ALGORITHM FOR EXTRA-LABEL DRUG USE [FARM ANIMAL]

Algorithm

Downloadable Version: OSUCVM ABX Use – Algorithm for Food Animal Extra-Label Drug Use

(Please note that there is currently an display issue with the interactive widget on Safari, which includes all browsers on iPhone / iPad)

An interactive H5P element has been excluded from this version of the text. You can view it online here: https://ohiostate.pressbooks.pub/osuvmcabxuse/?p=164#h5p-1

Antimicrobial Drugs Prohibited for Extra-Label Use in Food Animals

(Current as of January 5, 2018. Check for updates at this linked resource.)

21 CFR Part 530.41 Drugs prohibited for extralabel use in animals.

The following drugs, families of drugs, and substances are prohibited for extralabel animal and human drug uses in food-producing animals.

1. Chloramphenicol;
2. Clenbuterol;
3. Diethylstilbestrol (DES);
4. Dimetridazole;
5. Ipronidazole;
6. Other nitroimidazoles;
7. Furazolidone.

8. Nitrofurazone.
9. Sulfonamide drugs in lactating dairy cattle (except approved use of sulfadimethoxine, sulfabromomethazine, and sulfaethoxypyridazine);
10. Fluoroquinolones; and
11. Glycopeptides.
12. Phenylbutazone in female dairy cattle 20 months of age or older.
13. Cephalosporins (not including cephapirin) in cattle, swine, chickens, or turkeys:
    1. For disease prevention purposes;
    2. At unapproved doses, frequencies, durations, or routes of administration; or
    3. If the drug is not approved for that species and production class.

The following drugs, or classes of drugs, that are approved for treating or preventing influenza A, are prohibited from extralabel use in chickens, turkeys, and ducks:

1. Adamantanes.
2. Neuraminidase inhibitors.

FDA RESTRICTED AND PROHIBITED DRUGS [FARM ANIMAL]

GROUP I. Drugs with No Allowable Extra-Label Uses in Any Food-Producing Animal Species

- **CHLORAMPHENICOL**
- **CLENBUTEROL**
- **DIETHYLSTILBESTEROL (DES)**
- **FLUOROQUINOLONE–CLASS ANTIBIOTICS**
- **GLYCOPEPTIDES** – all agents, including **VANCOMYCIN**
- **MEDICATED FEEDS**
- **NITROIMIDAZOLES** – all agents, including **DIMETRIDAZOLE**, **IPRONIDAZOLE**, **METRONIDAZOLE** and others
- **NITROFURANS** – all agents, including **FURAZOLIDINE**, **NITROFURAZONE** and others

GROUP II. Drugs with Restricted Extra-Label Uses in Food-Producing Animal Species

- **ADAMANTANE & NEURAMINIDASE INHIBITORS** – Extra-label use (ELDU) of these drugs is **prohibited** in poultry including chickens, turkeys and ducks in the United States. Although these drugs are **not approved for use in animals in the United States**, some of these drugs are used in other countries for the treatment or prevention of avian influenza in chickens, turkeys and ducks.
- **CEPHALOSPORINS**
    - ELDU of all cephalosporin antibiotics, except CEPHAPIRIN, is **restricted** in

the United States. ELDU restrictions differ for Major vs. Minor Food Animal

- Species as noted below:
  - **Major Food Animal Species**(Cattle, Pigs, Chickens and Turkeys): ELDU is permissible only for therapeutic indications that are not included on the product label. However, ELDU of cephalosporin antibiotics is **prohibited** in all of the following situations:
    - a) the intended use of the product deviates from the approved dose, treatment duration, frequency or administration route on the product label,
    - b) the intended use of a product in an unapproved major species or animal production class,
    - c) the intended use of the product for the purpose of disease prevention.
  - **Minor Food Animal Species**(all species that are not major species): ELDU of cephalosporin antimicrobial agents is permitted in these species.

- **GENTIAN VIOLET** – use is **prohibited** in food or feed of all food-producing animal species
- **INDEXED DRUGS** – ELDU of these drugs is **prohibited** in all food producing animals, with some exceptions for minor-use animal species that are not used as food for humans or other animals.
- **PHENYLBUTAZONE** – all uses of this drug is **prohibited** in female dairy cattle greater than 20 months of age.
- **SULFONAMIDE–CLASS ANTIBIOTICS**
  - ELDU of all sulfonamides and potentiated sulfonamides is prohibited in adult lactating dairy cattle or dairy cattle greater than 20 months of age.
  - Only labeled uses of approved sulfonamides are allowed.
  - ELDU of sulfonamides in milking sheep and goats is discouraged but not prohibited.

KEY DEFINITIONS

Antibiotic Basics[1]

1. **Bactericidal:** substance that kills bacterial organisms
2. **Bacteriostatic:** substance that prevents growth of bacterial organisms

Pharmacodynamics

1. **Minimum Inhibitory Concentration:** "Minimum inhibitory concentrations (MICs) are defined as the lowest concentration of an antimicrobial that will inhibit the visible growth of a microorganism after overnightincubation", longer for slower growing organisms
2. **Time Dependent Antibiotic:** Antibiotics that must maintain a concentration level 40-50% above the minimum inhibitory concentration (MIC) of their target organism for a defined period of time to achieve efficacy. Shorter dosing intervals will improve efficacy in these substances by increasing the amount of time drug concentration remains above the MIC.
3. **Concentration Dependent Antibiotic:** Antibiotics that kill bacteria at a higher rate when their serum concentration is at its peak (C_{max}). Increasing drug dosage is effective at reaching C_{max} while also lengthening the amount of time that the drug concentration remains above the minimum inhibitory concentration MIC (area under the inhibitory curve).

1. It is important to note that the true nature of antibacterial drugs is not as 'black and white' as simply categorizing them as bacteriostatic or bactericidal. These terms are assigned through in vitro testing and activity can vary in vivo. It is more accurate to acknowledge that most antibacterial drugs can have both bactericidal and bacteriostatic activity depending on host factors, microbial factors, treatment duration, and drug concentration.Therefore, it would be more accurate to say that an antibiotic is 'primarily bacteriostatic' or 'primarily bactericidal'

SELECTED ANTIMICROBIAL INFORMATION - COMPANION ANIMAL

AMIKACIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Extra-label-use**	10-14mg/kg SQ, IM or IV q24h
Dogs	**Label dose for susceptible skin/soft tissue infections and UTIs**	10mg/kg SQ or IM q12h (can be used q24h extra-label)
	For susceptible infections or empirical therapy, including treatment of sepsis	15mg/kg SQ, IM or IV q24h (extra-label use)

Brand Name(s)

Amikin®, Amiglyde-V®

Background

Amikacin is a bactericidal, concentration-dependent aminoglycoside antibiotic with efficacy primarily against Gram-negative aerobic organisms, with somewhat less efficacy against Gram-positive aerobes. Many *Staphylococcus* spp. are susceptible. Amikacin is **not effective** against anaerobic bacteria and often not efficacious against *Streptococcus* spp. Oral absorption is poor. Distribution is throughout the extracellular fluid, but may be wider in states of inflammation. Excretion is primarily as active drug in urine. There is a significant post-antibiotic effect.

Acceptable Uses

- Treatment of genitourinary infections, particularly when culture/susceptibility demonstrates resistance to other antimicrobial choices (i.e. Amoxicillin, Trimetoprim-Sulfa).
- Treatment of skin (superficial and deep pyoderma), soft tissue, or orthopedic infections, particularly when culture/susceptibility demonstrates resistance to other antimicrobial choices.
- Treatment of respiratory infections, particularly when culture/susceptibility demonstrates resistance to other antimicrobial choices.

- Treatment of sepsis, bacteremia, or infectious endocarditis. Often used in combination with a penicillin or cephalosporin for broad spectrum coverage.
- As an alternative to gentamicin, particularly in cases of gentamicin resistance or where adverse effects preclude use.

Unacceptable Uses

- Treatment of Gram-positive infections when used alone, unless a culture-confirmed susceptible organism is identified.
- Anaerobic infections.

Formulations Available within the OSU Pharmacy

- Amikacin 1% topical
- Amikacin 250mg/ml injectable suspension
- Amiglyde 50mg/ml intrauterine solution

Notes

- Nephrotoxicity (acute tubular nephrosis) is a significant side effect that can be avoided by following dosing recommendations, minimizing duration of therapy, maintaining hydration status of patient, minimizing use of concurrently nephrotoxic drugs, using topical or local use whenever possible, and/or seeking alternative antimicrobial treatment in patients with pre-existing renal disease. Serum creatinine concentration should be assessed every 1-2 days during treatment. Small changes (i.e. 0.3 mg/dl) in blood creatinine concentration should be regarded as significant and promote reassessment of the treatment. Additionally or alternatively, assessment of total urine production and the production of urine casts should be done every 1-2 days during treatment to determine if renal damage is occurring.
- Ototoxicity is also a significant side effect.
- Cats may be more susceptible to negative side effects than dogs.
- Greyhounds (and other sighthounds) should be dosed at the lower end of the dose range.

AMOXICILLIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
	Label dose	50mg/cat (11-22mg/kg) PO q24h for 5-7d (can be used q12h extra-label)
Cats	**For soft tissue infections**	6-22mg/kg PO PO q8h for 5-7d (extra-label use)
	For sepsis	22-30mg/kg IV, SQ, or PO q8h for 5-7d (extra-label use)
	Label dose	11mg/kg PO q12h
	For uncomplicated UTI	10-20mg/kg PO q12h for 5-7d (extra-label use)
Dogs	**For soft tissue infections**	10-20mg/kg PO q8h for 7d (extra-label use)
	For sepsis or orthopedic infections	22-30mg/kg IV, IM, SQ, or PO q6-8h (extra-label use)
	For Lyme Disease	20mg/kg PO q8h for 30d (extra-label use)

Brand Name(s)

Amoxil®, Amoxi-Tabs®, Amoxi-Drops®, Biomox®, etc.

Background

Amoxicillin is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin, though with somewhat less activity against Gram-positive organisms. There is also some efficacy against anaerobes. Amoxicillin distributes widely through the plasma and can cross the blood-brain barrier when meninges are inflamed although it is uncertain if therapeutic concentrations are achieved. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily as unchanged drug in urine.

Except for uncomplicated (lower) urinary tract infections, amoxicillin should not be used to treat infections caused by Enterobacterales (e.g., *E. coli, Klebsiella* spp., *Proteus* spp., *Enterobacter* spp.) due to the inability of this drug to reach an effective inhibitory serum concentration for the required period when recommended dose regimen are used.

Acceptable Uses

- First line choice for empiric treatment of uncomplicated (lower) urinary tract infections.
- Treatment of susceptible nasopharyngeal, upper, or lower respiratory tract infections (except for infections caused by Enterobacterales and *Staphylococcus* spp.)
- Treatment of susceptible otitis media (except for infections caused by Enterobacterales and *Staphylococcus* spp.)
- Treatment of susceptible soft tissue infections (except for infections caused by Enterobacterales and *Staphylococcus* spp.)
- Treatment of Lyme Disease (borreliosis).
- Can be used as an oral alternative to ampicillin.

Unacceptable Uses

- First line or empirical treatment of suspected *Staphylococcus* spp. infections due to widespread resistance.
- Soft tissue infections (e.g., wounds, otitis, pneumonia, among others) caused by Enterobacterales and *Staphylococcus spp*.

Formulations Available within the OSU Pharmacy

- Amoxicillin 40mg/mL oral suspension
- Amoxi-Tabs 100mg tablets
- Amoxi-Tabs 150mg tablets
- Amoxi-Tabs 200mg tablets
- Amoxi-Tabs 400mg tablets

Notes

- Ampicillin is used to predict amoxicillin susceptibility on the culture/susceptibility report (due to similarities in composition and mechanisms of action).

AMOXICILLIN-CLAVULANIC ACID [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	62.5mg/cat PO q12h; duration of treatment not exceeding 30d
	For uncomplicated UTI	62.5mg/cat PO q12h for 10-30d
	For skin (pyoderma) or soft tissue infections	62.5mg/cat PO q12h for 5-7d or 11-22mg/kg PO q12h for 7-10d, or until infection has cleared (extra-label use)
	For sepsis	10-20mg/kg PO q8h for 7-10d (extra-label use)
Dogs	**Label dose**	13.75mg/kg PO q12h; duration of treatment not exceeding 30d
	For uncomplicated UTI	12.5mg/kg PO q12h for 5-7d (extra-label use)
	For skin (superficial pyoderma) and soft tissue infections	12.5-25mg/kg PO q12h to resolution of clinical signs or one week past resolution (extra-label use)
	For deep pyoderma	12.5-25mg/kg q12h for 14d or longer
	For systemic infections, including bacteremia or infectious endocarditis	12.5-25mg/kg PO q8h (extra-label use)

Brand Name(s)

Clavamox®, Augmentin®

Background

Amoxicillin-clavulanic acid is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin. The addition of clavulanic-acid improves activity against β-lactamase-producing bacteria. Activity against Gram-positive organisms is comparable to amoxicillin and ampicillin. Amoxicillin-clavulanic acid distributes widely through the plasma, and can cross the blood-brain barrier when meninges are inflamed although it is uncertain if therapeutic concentrations are achieved. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily as unchanged drug in urine.

Except for uncomplicated (lower) urinary tract infections, amoxicillin-clavulanic acid should not be used to treat infections caused by Enterobacterales (e.g., *E. coli, Klebsiella* spp., *Proteus* spp., *Enterobacter* spp.) due to the inability of this drug to reach an effective inhibitory serum concentration for the required period when recommended dose regimen are used.

Acceptable Uses

- Treatment of skin and soft tissue infections, particularly those associated with β-lactamase-producing *Staphylococcus pseudintermedius* and other *Staphylococcus* spp (*aureus, schleiferi, coagulans)*.
- When used in combination with topical therapy, treatment of otitis media or interna (except for infections caused by Enterobacterales and methicillin-resistant *Staphylococcus* spp).
- When used in combination with local therapy, treatment of gingivitis.
- When used in combination with local therapy, for treatment of anal sacculitis.
- Treatment of respiratory tract infections, including bacterial feline upper respiratory tract infections with a confirmed or highly suspected bacterial component, and infections in dogs associated with *Bordetella bronchiseptica*.
- Less preferred empirical treatment of uncomplicated urinary tract infections, particularly those caused by susceptible *E. coli* or *Proteus* spp.
- As an oral alternative to ampicillin-sulbactam.

Unacceptable Uses

- Soft-tissue infections (e.g., wounds, otitis, pneumonia, among others) caused by Enterobacterales.

Formulations Available within the OSU Pharmacy

- Clavamox 62.5mg/ml oral suspension
- Clavamox 62.5mg tablet
- Clavamox 125mg tablet
- Clavamox 250mg tablet
- Clavamox 375mg tablet

Notes

- Clavulanic acid has a shorter half-life than amoxicillin, leading some pharmacologists to advocate q8h dosing to maintain a ratio of amoxicillin to clavulanic acid with optimal bactericidal activity.
- Amoxicillin is preferred over amoxicillin-clavulanic acid for treatment of uncomplicated (lower) UTI. Clavulanic acid adds little to overall activity against Gram-negative aerobes such as *E. coli*, which are the most likely differential diagnosis. Amoxicillin has a narrower spectrum of activity and is the more responsible stewardship choice.

AMPICILLIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	6.6mg/kg SQ or IM q12h
	For systemic infections	10-20mg/kg IV, IM, or SQ q8-12h (extra-label use)
Dogs	**Label dose**	6.6mg/kg SQ or IM q12h
	For soft tissue infections	10-20mg/kg SQ or IM q12h for 7d (extra-label use)
	For sepsis, meningitis, or orthopedic infections	22mg/kg IV, IM, or SQ q6-8h (extra-label use)
	For neonatal sepsis	50mg/kg IV or IO q4-6h (extra-label use)
	For leptospirosis	20mg/kg IV q6h until de-escalation to oral therapy is possible (extra-label use)
	For infectious endocarditis	20-40mg/kg IV q6-8h

Brand Name(s)

Polyflex®

Background

Ampicillin is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin, though with somewhat less activity against Gram-positive organisms. There is also some efficacy against anaerobes. Ampicillin distributes widely through the plasma, and can cross into the prostate, the eye, and the blood-brain barrier when there is

inflammation. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily as active and metabolized drug in urine.

Except for uncomplicated (lower) urinary tract infections, ampicillin should not be used to treat infections caused by Enterobacterales (e.g., *E. coli, Klebsiella* spp., *Proteus* spp., *Enterobacter* spp.) due to the inability of this drug to reach an effective inhibitory serum concentration for the required period when recommended dose regimen are used.

Acceptable Uses

- Treatment of bacterial respiratory tract infections.
- Treatment of soft tissue or orthopedic infections.
- Treatment of gastrointestinal infections associated with susceptible *Enterococcus* spp., *Staphylococcus* spp., or *E. coli*.
- Treatment of bacterial endocarditis, bacteremia, or sepsis. Often used in combination with an aminoglycoside or a fluoroquinolone.
- Initial treatment for leptospirosis in dogs who cannot tolerate oral doxycycline administration due to intractable vomiting.
- As a parenteral alternative to amoxicillin.
- Treatment of susceptible soft tissue infections (except for infections caused by Enterobacterales and *Staphylococcus* spp).

Unacceptable Uses

- When used alone, empirical treatment of suspected *Staphylococcus* spp. infections due to widespread resistance.
- Soft tissue infections (e.g., wounds, otitis, pneumonia, among others) caused by Enterobacterales and *Staphylococcus spp*.

Formulations Available within the OSU Pharmacy

- Ampicillin 1g/vial injectable suspension
- Ampicillin 500mg/vial injectable suspension
- Ampicillin NA 1g/vial injectable suspension
- Ampicillin NA 500mg/vial injectable suspension

Notes

- Ampicillin trihydrate (Polyflex®) should not be given IV due to risk of anaphylaxis and sudden death. Ampicillin sodium is safe for IV injection.
- Although ampicillin is recommended as initial treatment in patients with leptospirosis that will not tolerate oral medications (i.e. because of vomiting), treatment with ampicillin does not clear infection with *Leptospira* spp. in companion animals and should be followed by oral doxycycline once vomiting resolves.

AMPICILLIN-SULBACTAM [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For susceptible infections**	10-20mg/kg IV or IM q8h, given slowly (extra-label use)
	As part of a treatment regimen for sepsis	30mg/kg IV q6-8h (extra-label use)
	As a CRI	3.75-8.3mg/kg/hr (extra-label use)
Dogs	**For susceptible infections**	10-20mg/kg IV or IM q8h, given slowly (extra-label use)
	As part of a treatment regimen for sepsis	30mg/kg IV q6-8h (extra-label use)
	As a CRI	3.75-8.3mg/kg/hr (extra-label use)

Brand Name(s)

Unasyn®

Background

Ampicillin sodium-sulbactam sodium is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin. The addition of sulbactam improves activity against β-lactamase-producing bacteria, such as *Staphylococcus* spp., though clavulanic acid is a more potent β-lactamase inhibitor. Activity against Gram-positive organisms is comparable to amoxicillin and ampicillin. Ampicillin-sulbactam distributes widely through the plasma, including into peritoneal and interstitial fluid. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily in urine.

Acceptable Uses

- Treatment of infections susceptible to amoxicillin-clavulanic acid in patients unable to tolerate oral medication.
- Treatment of soft tissue or orthopedic infections.
- Treatment of genitourinary infections.
- Treatment of intra-abdominal infections.
- In combination with an aminoglycoside or fluoroquinolone, part of broad-spectrum therapy for sepsis or other critical systemic infections.
- As a parenteral alternative to amoxicillin-clavulanic acid.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Ampicillin/Sulbactam 1.5g (Ampicillin 1g/Sulbactam 0.5g)/vial injectable suspension
- Ampicilin/Sulbactam 3g (Ampicillin 2g/Sulbactam 1g)/vial injectable suspension
- Unasyn 1.5g/vial injectable suspension
- Unasyn 3g/vial injectable suspension

Notes

- N/A

AZITHROMYCIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For respiratory infections associated with *Mycoplasma***	5-15mg/kg PO q24h for 5d, then q72h for 6-8wks (extra-label use)
	For other bacterial infections	7-15mg/kg PO q12h for 5-7d (extra-label use)
	For toxoplasmosis	10mg/kg PO q24h for 4wks (would not be first choice-see Clindamycin) (extra-label use)
	For susceptible infections	5-10mg/kg PO q24h for 3-7d (up to 10-20d for skin infections) (extra-label use)
Dogs	**For *Babesia***	10-11.6mg/kg PO q24h for 10d, given in combination with atovaquone (extra-label use)
	For *Giardia*	5mg/kg PO q24h for 5d (Would not be first choice. Note there are no drugs approved for the treatment of giardiasis in dogs and cats in the USA.) (extra-label use)

Brand Name(s)

Zithromax®

Background

Azithromycin is a bacteriostatic, time-dependent macrolide antibiotic. It has activity against some Gram-positive aerobes as *Staphylococcus* spp., and some Gram-negative aerobes, such as *Bordetella bronchiseptica*. It is also active against many spirochetes and intracellular organisms, though there are exceptions (see *Unacceptable Uses*). Azithromycin is **not effective** against *Pseudomonas aeruginosa*, and many *Enterobacteriaceae* have acquired resistance. It is widely distributed, and can be used in the presence of necrotic tissue. Excretion is primarily in bile.

Acceptable Uses

- Treatment of systemic infections.
- Treatment of bacterial upper respiratory infection in cats associated with *Mycoplasma* spp.

- Treatment of some protozoal infections, such as *Babesia* spp., *Giardia* spp., *Cryptosporidium* spp., or *Toxoplasma gondii*.

Unacceptable Uses

- Cats with hemotropic mycoplasmas (e.g. *Mycoplasma haemofelis*) or *Chlamydophila felis* infections will not clear infection after treatment with azithromycin.

Formulations Available within the OSU Pharmacy

- Azithromycin 20mg/ml oral suspension
- Azithromycin 250mg tablet

Notes

- Gastrointestinal adverse effects are less severe compared to erythromycin, which acts as a potent prokinetic agent.

CEFADROXIL [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	Label dose	22mg/kg PO q12h (dose q24h if there is renal impairment); duration of treatment not exceeding 21d
Dogs	Label dose	22mg/kg PO q12h for 3-7d; duration of treatment not exceeding 30d
	For pyoderma	22-35mg/kg PO q12h to resolution of clinical signs or one week past resolution (extra-label use)
	For systemic or orthopedic infections	22mg/kg PO q8-12h for 30d (extra-label use)
	For UTI	11-12mg/kg PO q12h for 7-30d (extra-label use)

Brand Name(s)

Cefa-Drops®, Duricef®

Background

Cefadroxil is a bactericidal, time-dependent first generation cephalosporin (β-lactam) antibiotic with activity primarily against Gram-positive aerobes, and more limited activity against Gram-negative aerobes. Activity against anaerobes is poor. Cefadroxil is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide, but cefadroxil does not penetrate intracellularly or cross the blood-brain barrier. Excretion is primarily as active drug in urine.

Acceptable Uses

- Treatment of susceptible skin (pyoderma), soft tissue, or orthopedic infections.
- Treatment of susceptible respiratory infections, particularly those associated with *Streptococcus* or *Staphylococcus* spp.
- Treatment of urinary tract infections.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- No formulations currently available within the OSU pharmacy; will order upon request

Notes

- Cefadroxil is longer-acting compared to other first generation cephalosporins, such as cephalexin.

CEFAZOLIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
	For surgical prophylaxis	20-22mg/kg IV once 60min prior to incision, repeated q90-120min until wound closure (extra-label use)
Cats		
	For susceptible infections	15-35mg/kg IV, IM, or SQ q6-8h (extra-label use)
	For surgical prophylaxis	20-22mg/kg IV once 60min prior to incision, repeated q90-120min until wound closure (extra-label use)
Dogs		
	For susceptible infections	15-35mg/kg IV, IM, or SQ q6-8h (extra-label use)

Brand Name(s)

Ancef®, Kefzol®, Zolicef®

Background

Cefazolin is a bactericidal, time-dependent first generation cephalosporin (β-lactam) antibiotic with activity primarily against Gram-positive aerobes, and more limited activity against Gram-negative aerobes. Activity is poor against anaerobes. Cefazolin is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus*

Acceptable Uses

- Surgical prophylaxis, particularly for prolonged orthopedic procedures. Most efficacious

against Gram-positive aerobic organisms. Poor choice for colorectal surgery.

- Treatment for systemic infections (e.g. sepsis) caused by susceptible organisms.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cefazolin 1g/10ml injectable suspension

Notes

- N/A

CEFOTAXIME [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For soft tissue infections**	50mg/kg IV q12h for up to 7d(extra-label use)
	For orthopedic infections	50mg/kg IV q12h for up to 7d (extra-label use)
	For bacteremia	50mg/kg IV q12h (extra-label use)
	For CRI	3.2mg/kg IV once followed by CRI of 5mg/kg/hr (extra-label use)
Dogs	**For soft tissue infections**	50mg/kg IV q12h for up to 7d (extra-label use)
	For orthopedic infections	50mg/kg IV q12h for up to 7d (extra-label use)
	For bacteremia	50mg/kg IV q12h (extra-label use)
	For CRI	3.2mg/kg IV once followed by CRI of 5mg/kg/hr (extra-label use)

Brand Name(s)

Claforan®

Background

Cefotaxime is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with increased activity against Gram-negative bacteria such as *Enterobacteriaceae* when compared to first and second generation cephalosporins (e.g. cefazolin), and variable activity against anaerobes. It is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide, and cefotaxime can cross the blood-brain barrier and achieve therapeutic concentrations. Excretion is primarily in urine.

Acceptable Uses

- Treatment of infections where IV therapy is indicated, such as severe soft tissue/orthopedic infections or bacteremia.
- Empiric treatment for suspected gram-negative sepsis.

- As a parenteral alternative to cefpodoxime.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cefotaxime 10g/100ml injectable suspension

Notes

- It is recommended that this medication be used only via IV administration due to pain and injection site reactions with SQ or IM administration

CEFOVECIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	8mg/kg SQ once; therapeutic concentrations are maintained for approximately 7d
	Treatment of periodontitis/ gingivitis or UTI	Extra-label use
Dogs	**Label dose**	8mg/kg SQ once; therapeutic concentrations are maintained for approximately 7-14d (dependent on organism)
	Treatment of periodontitis/ gingivitis or UTI	Extra-label use

Brand Name(s)

Convenia®

Background

Cefovecin is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with a long half-life. Activity against Gram-negative organisms is greater than first or second generation cephalosporins, but less compared to other third-generations cephalosporins. Activity against anaerobes is variable. It is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, *Bordetella bronchiseptica*, and methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide and excretion is primarily as active drug in urine.

Acceptable Uses

- Treatment of skin infections (e.g. pyoderma, wounds, abscesses) associated with susceptible *Staphylococcus pseudintermedius* or *Streptococcus canis* in dogs, or *Pasteurella multocida* in cats.
- When used in combination with mechanical cleaning, treatment of periodontitis or gingivitis.

- Less preferred treatment for urinary tract infections when oral treatment is not possible.

Unacceptable Uses

- Generally, less efficacious or ineffective at treating upper respiratory tract disease in cats and dogs.

Formulations Available within the OSU Pharmacy

- Convenia 80mg/ml injectable suspension

Notes

- Long-term excretion in urine (approximately 14d for dogs, 21d for cats) may make interpretation of post-treatment urine cultures difficult.

CEFOXITIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For systemic infections**	25-30mg/kg IV q8h (extra-label use)
	For soft tissue or orthopedic infections	30mg/kg IV q8h (extra-label use)
Dogs	**For bacteremia**	30mg/kg IV q6-8h (extra-label use)
	For surgical prophylaxis	22mg/kg IV given 30-60min prior to incision; may repeat once in 3-6h (extra-label use)

Brand Name(s)

Mefoxin®

Background

Cefoxitin is a bactericidal, time-dependent second generation cephamycin (β-lactam) antibiotic often grouped with second generation cephalosporins. It has good activity against many Gram-negative organisms and also anaerobes, but less activity against Gram-positive organisms compared to first generation cephalosporins. It is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, *Salmonella* spp., and methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide but it does not enter the CNS, and excretion is primarily as unchanged drug in urine.

Acceptable Uses

- Parenteral treatment of a wide variety of Gram-negative aerobic infections, including sepsis, pyothorax, or osteomyelitis.
- Surgical prophylaxis particularly when anaerobic infections are expected, such as colorectal surgery. Also useful for treating intra-abdominal bowel rupture.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- No formulations currently available within the OSU pharmacy; will order upon request

Notes

- It is recommended that this medication be used only via IV administration due to pain and injection site reactions with SQ or IM administration.
- Cefoxitin can be used initially for parenteral treatment of severe infections, and then therapy can be de-escalated to oral treatment long term.

CEFPODOXIME [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Treatment of upper respiratory infections, urinary tract infections, pyoderma, or otitis media/interna**	5mg/kg PO q12h *or* 10mg/kg PO q24h for 5-7d or until infection is cleared (extra-label use)
Dogs	**Label dose**	5-10mg/kg PO q24h for 5-7d, treatment not exceeding 28d

Brand Name(s)

Simplicef®, Vantin®

Background

Cefpodoxime is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with excellent activity against Gram-negative bacteria such as *Enterobacteriaceae*. It is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus* spp., or anaerobes. Distribution throughout the body is wide, but cefpodoxime does not penetrate intracellularly or cross the blood-brain barrier. Excretion is primarily in urine.

Acceptable Uses

- Treatment of upper respiratory infections, urinary tract infections, pyoderma, or otitis media/interna not responsive or resistant to other antimicrobial choices.
- As an oral alternative to cefotaxime.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cefpodoxime 100mg tablet

- Cefpodoxime 200mg tablet

Notes

- Feline dosing recommendations are extrapolated from human data.

CEFTAZIDIME [COMPANION]

Restriction Status

Selectively Use

Dose

Species	Usage	Dose
Cats	**Treatment of *Pseudomonas aeruginosa* or Gram-negative aerobic infections not susceptible to other antibiotics**	30mg/kg IV q6h (reduce frequency of administration to q8h in patients with renal insufficiency) (extra-label use)
	For CRI	3-4mg/kg IV loading dose, then 3-4mg/kg/hr IV CRI (extra-label use)
Dogs	**For orthopedic infections**	30mg/kg IV q6h (reduce frequency of administration to q8h in patients with renal insufficiency) (extra-label use)
	For soft tissue infections	30mg/kg IV q6h (reduce frequency of administration to q8h in patients with renal insufficiency) (extra-label use)
	For sepsis	30mg/kg IV q4-8h (extra-label use)
	For CRI	3-4mg/kg IV loading dose, then 3-4mg/kg/hr IV CRI (extra-label use)

Brand Name(s)

Ceptaz®, Fortaz®, Tazicef

Background

Ceftazidime is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with excellent activity against Gram-negative bacteria such as *Enterobacteriaceae* and *Pseudomonas*

aeruginosa. There is some activity against anaerobes. It is **not effective** against *Enterococcus* spp. or methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide, and ceftazidime reaches therapeutic concentrations in both bone and CSF. Elimination is primarily as unchanged drug in urine.

Acceptable Uses

- Treatment of *Pseudomonas aeruginosa* or Gram-negative aerobic infections not susceptible to other antibiotics, including sepsis, meningitis, osteomyelitis, or pneumonia. Sometimes used in combination with an aminoglycoside or clindamycin when antimicrobial resistance is anticipated.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Ceftazidime 2g/10ml injectable suspension

Notes

- This should be used selectively (i.e. as a second resource drug).
- It is recommended that this medication be used only via IV administration due to pain and injection site reactions with SQ or IM administration.

CEPHALEXIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For soft tissue infections**	15-30mg/kg PO q12h for 14-28d (extra-label use)
	For systemic infections	35mg/kg PO q6-8h for 14-28d if indicated by culture/susceptibility (extra-label use)
	Label dose	22mg/kg PO q12h for up to 28d
	For pyoderma	22-35mg/kg PO q12h
Dogs	**For respiratory tract infections**	20-40mg/kg PO q8h for 7-14d if indicated by culture/susceptibility (extra-label use)
	For systemic infections	25-45mg/kg PO q8h for 14-28d if indicated by culture/susceptibility (extra-label)
	For orthopedic infections	22-30mg/kg PO q6-8h for 28d (extra-label)
	For urinary tract infections	15mg/kg PO q6-8h for 14-28d (extra-label)

Brand Name(s)

Rilexine®, Keflex®

Background

Cephalexin is a bactericidal, time-dependent first generation cephalosporin (β-lactam) antibiotic with activity primarily against Gram-positive aerobes, and more limited activity against Gram-negative aerobes and anaerobes. Cephalexin is **not effective** against *Enterococcus* spp., *Pseudomonas aeruginosa*, and methicillin-resistant *Staphylococcus* spp. Distribution throughout the body is wide, including into bone, but cephalexin does not penetrate intracellularly or cross the blood-brain barrier. Excretion is primarily in urine and bile.

Acceptable Uses

- First line empiric treatment of pyoderma associated with susceptible *Staphylococcus* spp. Culture/susceptibility are recommended if not a first-time infection.

- Treatment of other susceptible soft tissue infections.
- Less preferred treatment for urinary tract infections.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cephalexin 250mg capsule
- Cephalexin 500mg capsule
- Cephalexin 50mg/ml oral suspension

Notes

- N/A

CHLORAMPHENICOL [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For oral use**	12.5-20mg/kg q12h for 7-14d (treatment should not exceed 14d) (extra-label use)
	For parenteral use	12-30mg/kg q12h IV (extra-label use)
Dogs	**For oral use**	45-60mg/kg q8h for 7d-14d (treatment should not exceed 14d) (extra-label use)
	For parenteral use	45-60mg/kg q6-8h IV (extra-label use)

Brand Name(s)

Viceton®, Chloromycetin®

Background

Chloramphenicol is a bacteriostatic, time-dependent acetamide antibiotic with a very broad spectrum of activity, including Gram-positive and Gram-negative aerobes, and anaerobes. It is **not effective** against *Pseudomonas aeruginosa*. Plasmid-mediated resistance to chloramphenicol develops in Gram-negative bacteria (e.g. *Enterobacter cloacae*, *Klebsiella* spp.) over time. Chloramphenicol is widely distributed throughout the body, crosses the blood-brain barrier, and penetrates necrotic tissues and abscesses. Elimination is through hepatic metabolism, and inactive metabolites are excreted in urine.

Acceptable Uses

- Treatment of conditions in which broad-spectrum coverage is required (pneumonia, peritonitis, internal abscesses, cellulitis, etc.). Culture/susceptibility are indicated prior to initiating therapy.
- Treatment of rickettsial infections.
- Pyoderma in dogs.

Unacceptable Uses

- Should not be used in animals with pre-existing leukopenia or anemia.

Formulations Available within the OSU Pharmacy

- Chloramphenicol 1g tablet
- Chloramphenicol 250mg tablet

Notes

- Idiosyncratic, irreversible aplastic anemia is a rare complication of human exposure to chloramphenicol, which can lead to death. **Gloves should always be worn when handling chloramphenicol**.
- Reversible bone marrow suppression has also been noted in cats and dogs. Reversible bone marrow suppression is very common in cats, especially with treatment >14 days. It is rare in dogs.
- Reversible peripheral neuropathy/hindlimb paresis of unknown etiology occurs in up to 30% of dogs treated with chloramphenicol.
- Chloramphenicol can decrease the clearance of other hepatically-metabolized drugs (e.g. barbituates).
- GI side effects (i.e. vomiting and anorexia) are common in dogs and cats treated with chloramphenicol.
- When given orally, chloramphenicol should be administered with food to improve its absorption.
- It is very difficult to find injectable formulations of chloramphenicol.

CIPROFLOXACIN [COMPANION ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For susceptible pathogens**	5-15mg/kg PO q12h (extra-label use)
Dogs	**For susceptible pathogens**	5-15mg/kg PO q12h (extra-label use)

Brand Name(s)

Cipro®

Background

Ciprofloxacin is a bacteriocidal, concentration-dependent fluoroquinolone antibiotic with broad-

spectrum activity against both gram-positive and gram-negative bacteria. It has good activity against *Pseudomonas aeruginosa* and *Klebsiella* spp., although resistance does occur in these bacteria. Gram-positive coverage is limited and often includes *Staphylococcus* spp., but ciprofloxacin is **not effective** against *Enterococcus* spp. and may not be effective against some *Streptococcus* spp. It is also **not effective** against anaerobes. This antimicrobial has poor bioavailability after oral dosing and is excreted in the urine and feces.

Acceptable Uses

- For bacterial infections that are susceptible to enrofloxacin but use of enrofloxacin is cost-prohibitive and no other options exist.

Unacceptable Uses

- Anaerobic infections, including empiric treatment of cat bite abscesses.
- Treatment of Gram-positive infections without known susceptibility results.
- Treatment of urinary tract infections or pyelonephritis where culture/susceptibility demonstrates susceptibility to lower tier antimicrobials.

Formulations Available within the OSU Pharmacy

- Ciprofloxacin 250 mg tablets
- Ciprofloxacin 750 mg tablets

Notes

- The bioavailability of ciprofloxacin is poor in dogs after oral dosing (less than ½ that of enrofloxacin).
- Ciprofloxacin is occasionally used as a cheaper alternative to enrofloxacin, but due to unpredictable absorption rates and the high likelihood of underdosing, this is recommended only as a last option.
- Ciprofloxacin should not be used in in young, growing animal due to adverse effects on cartilage.
- The dose of ciprofloxacin should be reduced in animals with severe renal failure.

CLINDAMYCIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	11-33mg/kg PO q24h for no more than 14d
	For skin or soft tissue infections	11-33mg/kg PO or SQ q24h for 7-28d *or* 5-11mg/kg PO or SQ q12h for 7-28d (extra-label use)
	For sepsis	10-15mg/kg IV q12h (extra-label use)
	For toxoplasmosis	10-15mg/kg PO or IV q12h
	For dental prophylaxis/ post-dental procedures	5-10mg/kg PO q12h for 5-8d (extra-label use)
	Most commonly used dose range	10-15mg/kg PO or IV q12h
Dogs	**Label dose**	5.5-33mg/kg PO q12h for no more than 28d
	For staphylococcal pyoderma	11mg/kg PO or SQ q24h *or* 5.5mg/kg PO q12h to resolution of clinical signs or one week past resolution (extra-label use)
	For staphylococcal osteomyelitis	11mg/kg PO q12h for 28-42d (q8h for anaerobic osteomyelitis) (extra-label use)
	For other wounds or abscesses, or dental infections	11-33mg/kg PO, SQ, or IV q12h for 7-28d (extra-label use)
	For dental prophylaxis/ post-dental procedures	5-10mg/kg PO q12h for 5-8d (extra-label use)
	For sepsis	10-15mg/kg IV q12h (extra-label use)
	For toxoplasmosis	10-15mg/kg PO or IV q12h
	Most commonly used dose range	10-15mg/kg PO or IV q12h

Brand Name(s)

Antirobe®, Cleoncin®

Background

Clindamycin is a bacteriostatic, time-dependent lincosamide antibiotic with good activity against Gram-positive organisms such as *Staphylococcus* spp., and many anaerobes. It is **not effective** against most Gram-negative aerobes including *Enterobacteriaceae* and *Pseudomonas aeruginosa*, and *Enterococcus* spp. are also intrinsically resistant. Distribution is wide, including into bone and across inflamed meninges. Both unchanged drug and metabolites are excreted in urine, feces, and bile.

Acceptable Uses

- Treatment of staphylococcal pyoderma. Acceptable as an empiric treatment.
- Treatment of other skin infections including abscesses and wounds, including those with an anaerobic component (e.g. cat bite abscess).
- Treatment of dental infections or as dental prophylaxis. Most efficacious when used with mechanical dental cleaning.
- Treatment of staphylococcal or anaerobic osteomyelitis.
- In combination with an antimicrobial with Gram-negative coverage, empiric treatment of sepsis or bacteremia.
- First choice of treatment for toxoplasmosis in dogs and cats.

Unacceptable Uses

- Treatment of suspected or culture-confirmed Gram-negative infections.
    - D-test (disk diffusion method using Clindamycin and Erythromycin disks) used to detect inducible Clindamycin resistance in *Staphylococcus* species.

Formulations Available within the OSU Pharmacy

- Clindamycin 25mg capsule
- Clindamycin 75mg capsule
- Clindamycin 150mg capsule
- Clindamycin 300mg capsule
- Clindamycin 25mg/ml oral suspension
- Clindamycin 150mg/ml injectable suspension

Notes

- N/A

DOXYCYCLINE [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For susceptible pathogens**	5mg/kg q12h PO or IV *or* 10mg/kg q24h PO or IV (extra-label use)
Dogs	**For susceptible pathogens**	5mg/kg q12h PO or IV *or* 10mg/kg q24h PO or IV (except for the treatment of heartworm disease) (extra-label use)
	For heartworm disease	10mg/kg PO q12h for 28d prior to treatment with adulticide (extra-label use)

Brand Name(s)

Vibramycin®, Adoxa®, Monodox®, Oracea®, Periostat®, Doryx®, etc.

Background

Doxycycline is a bacteriostatic, time-dependent tetracycline antibiotic with a broad spectrum of activity against many Gram-positive and Gram-negative aerobes. It is **not effective** against *Proteus* spp. or *Pseudomonas* spp. There is activity against some anaerobes, but efficacy against *Clostridium* spp. is variable. Intracellular organisms and spirochetes are often highly susceptible. Distribution is wide, and doxycycline crosses inflamed meninges. It is primarily excreted in feces.

Acceptable Uses

- Treatment of a wide variety of local or systemic bacterial infections, including urinary tract or respiratory tract infections and bacteremia.
- Treatment of intracellular infections, such as hemotropic *Mycoplasma* spp., *Chlamydia* spp., *Ehrlichia* spp., or *Anaplasma* spp.

- Treatment of spirochetal infections. Preferred treatment for Lyme disease (borreliosis) or leptospirosis.
- Pyoderma.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Doxycycline 20mg tablet
- Doxycycline 50mg capsule
- Doxycycline 100mg tablet
- Doxycycline 100mg capsule
- Doxycycline 100mg/10ml injectable suspension
- Vibramycin 10mg/ml oral suspension
- Vibramycin 50mg/5ml syrup

Notes

- Doxycycline is also often used in combination with melarsomine or another adulticidal drug as part of a treatment regimen for heartworm disease.
- Oral doxycycline is commercially available as either doxycycline hyclate or doxycycline monohydrate. Doxycycline hyclate dissociates into doxycycline and HCl, which can cause a chemical burn resulting in esophagitis in cats and small dogs. Owners should be warned to follow oral doxycycline administration with water or a small amount of food to prevent doxycycline becoming lodged in the esophagus.

ENROFLOXACIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	2.5mg/kg PO, IV or SQ q12h *or* 5mg/kg PO, IV, or SQ q24h for no more than 30d (ideally, 7-14d)
Dogs	**Label dose**	5-10mg/kg PO, IV or SQ q24h for no more than 30d (high end of dose range preferred for *Pseudomonas* soft tissue infections)
	For skin or genitourinary infections	5-10mg/kg PO q24h for 7-14d (for pyoderma, to resolution of clinical signs or one week past resolution)
	For deep pyoderma, lower respiratory tract infections, or complicated UTIs	5-20mg/kg PO, IV, or IM q24h for 7-14d (for pyoderma, to resolution of clinical signs or one week past resolution)
	For sepsis or orthopedic infection	10-20mg/kg PO, IV, IM, or SQ q24h
	For enteric infections	5mg/kg PO q12h; treatment may need to continue for up to 8wks in cases of granulomatous colitis
	For Otitis media (*Pseudomonas)*	20mg/kg q24h

Brand Name(s)

Baytril®

Background

Enrofloxacin is a bactericidal, concentration-dependent fluoroquinolone antibiotic with activity primarily against Gram-negative aerobes, such as *Enterobacteriaceae* and *Pseudomonas aeruginosa*. Gram-positive coverage is limited and often includes *Staphylococcus* spp., but enrofloxacin is **not effective** against *Enterococcus* spp. and may not be effective against some *Streptococcus* spp. It is also **not effective** against anaerobes. Distribution is wide; enrofloxacin crosses the blood-brain barrier and can enter abscesses, the prostate, and bone. Excretion is primarily in bile, with a component of active drug in urine.

Acceptable Uses

- Treatment of complicated or culture/susceptibility-confirmed resistant urinary tract infections, pyelonephritis, and prostatitis.
- Treatment of infected wounds or deep pyoderma associated with culture-confirmed susceptible organisms, or empiric treatment of suspected *Pseudomonas aeruginosa* (e.g. groomer-associated deep pyoderma). Also useful for treatment of otitis media/interna.
- Treatment of respiratory tract infections, including pneumonia.
- Treatment of osteomyelitis or septic arthritis, with or without the addition of rifampin.
- Treatment of enteric infections associated with Gram-negative organisms such as *E. coli* (granulomatous colitis) or *Campylobacter* spp.
- Superficial pyoderma based on C/S.

Unacceptable Uses

- Anaerobic infections, including empiric treatment of cat bite abscesses.
- Treatment of Gram-positive infections without known susceptibility results.
- Treatment of urinary tract infections or pyelonephritis where culture/susceptibility demonstrates susceptibility to lower tier antimicrobials.

Formulations Available within the OSU Pharmacy

- Enrofloxacin 100mg/ml injectable suspension
- Enrofloxacin 20mg/ml oral suspension
- Enrofloxacin 22.7mg tablet
- Enrofloxacin 68mg tablet
- Enrofloxacin 136mg tablet
- Baytril 22.7mg/ml injectable suspension
- Baytril 100mg/ml injectable suspension
- Baytril 22.7mg tablet
- Baytril 68mg tablet

Notes

- Enrofloxacin is metabolized *in vivo* to its active form, ciprofloxacin. Ciprofloxacin,

however, is less readily absorbed across the gastrointestinal tract in veterinary species when compared to enrofloxacin. PK/PD studies suggest that GI absorption of ciprofloxacin in dogs ranges from approximately 30-80%. Ciprofloxacin (Cipro®) is occasionally used as a cheaper alternative to enrofloxacin, but due to unpredictable absorption rates and the high likelihood of underdosing, this is not recommended.

- Retinal degeneration is a possible adverse side effect in cats, and enrofloxacin use is not recommended in this species where other antimicrobial choices are available. 5mg/kg/day is the maximum daily dose that should be given to cats.
- Enrofloxacin should not be used in young, growing animal due to adverse effects on cartilage.

IMIPENEM [COMPANION]

Restriction Status

Protected

Dose

Species	Usage	Dose
Cats	**For susceptible pathogens resistant to other antimicrobials**	5mg/kg IV q6-8h (reduce dose for patients with renal disease) or CRI (extra-label use)
Dogs	**For susceptible pathogens resistant to other antimicrobials**	5mg/kg IV q6-8h (reduce dose for patients with renal disease) or CRI (extra-label use)

Brand Name(s)

Primaxin®

Background

Imipenem is a bactericidal, time-dependent carbapenem (β-lactam) antibiotic with broad-spectrum activity against Gram-positive aerobes, Gram-negative aerobes, and anaerobes. Imipenem is formulated with cilastatin, which slows the metabolism of imipenem. Many *Enterobacteriaceae* that are resistant to other antimicrobials will be susceptible to imipenem; therefore, use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. Carbapenem resistance is a growing problem in human medicine and is expected to become an issue in veterinary medicine with time. Distribution of imipenem throughout the body is wide, and excretion is primarily in urine.

Acceptable Uses

- Treatment of severe infections that are culture-confirmed to be resistant to other antimicrobial choices. Particularly useful for Gram-negative infections.

Unacceptable Uses

- Empiric treatment, except in cases of sepsis or meningitis with a high index of suspicion for multidrug resistant infections.

Formulations Available within the OSU Pharmacy

- There are currently no formulations of imipenem available at the OSU pharmacy; available upon request

Notes

- Imipenem use in animals is highly controversial, and should only be considered as a last resort when other antimicrobial treatment options have been ruled out.
- Imipenem is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.
- It is recommended that this medication be used only via IV administration due to pain and injection site reactions with SQ or IM administration.

LINEZOLID [COMPANION]

Restriction Status

Protected

Dose

Species	Usage	Dose
Cats	**Treatment of multidrug resistant, Gram-positive infections causing life-threatening, systemic disease**	10mg/kg PO or IV q8-12h for 14d (extra-label use)
Dogs	**Treatment of multidrug resistant, Gram-positive infections causing life-threatening, systemic disease**	10mg/kg PO or IV q8-12h for 14d (extra-label use)

Brand Name(s)

Zyvox®

Background

Linezolid is a bacteriostatic, time-dependent oxazolidinone antibiotic with excellent activity against Gram-positive aerobes. Many *Staphylococcus* spp. and *Enterococcus* spp. that are resistant to other antimicrobials will be susceptible to linezolid; therefore, use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. It is **not effective** against Gram-negative aerobes or anaerobes. Linezolid is well absorbed after ingestion. Distribution is fairly wide, but poor into bone or cerebral spinal fluid. Linezolid is primarily excreted as metabolites and some active drug in urine and feces. There is a post-antibiotic effect.

Acceptable Uses

- Treatment of multidrug resistant, Gram-positive infections causing life-threatening, systemic disease. **Culture/susceptibility should be performed prior to use.**

Unacceptable Uses

- Empiric use.

Formulations Available within the OSU Pharmacy

- Linezolid 600mg tablet

Notes

- Linezolid use in animals is highly controversial, and should only be considered as a last resort when other antimicrobial treatment options have been ruled out.
- Linezolid is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.

MARBOFLOXACIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	2.75-5.5mg/kg PO q24h, for no longer than 30d
	For hemoplasmosis	2.75mg/kg PO q24h for 14-28d (extra-label use)
Dogs	**Label dose**	2.75-5.5mg/kg PO q24h, for no longer than 30d
	For *Pseudomonas* otitis media/interna	5.5mg/kg PO q24h (extra-label use)

Brand Name(s)

Zeniquin®

Background

Marbofloxacin is a bactericidal, concentration-dependent fluoroquinolone antibiotic with activity primarily against Gram-negative aerobes, such as *Enterobacteriaceae* and *Pseudomonas aeruginosa*. Gram-positive coverage is limited, and marbofloxacin is often **not effective** against *Enterococcus* spp. or *Streptococcus* spp., though it may be efficacious against *Staphylococcus* spp. It is also **not effective** against anaerobes. Distribution is wide, including into abscesses, and excretion is primarily as active drug in urine with a lesser component of biliary excretion. There is a post-antibiotic effect.

Acceptable Uses

- Treatment of complicated or culture/susceptibility-confirmed resistant urinary tract infections or pyelonephritis.
- Treatment of infected wounds or deep pyoderma associated with culture-confirmed

susceptible organisms.

- Treatment of otitis media associated with *Pseudomonas aeruginosa*.
- Treatment of hemoplasmosis in cats.
- As an alternative to enrofloxacin.

Unacceptable Uses

- Anaerobic infections, including empiric treatment of cat bite abscesses.
- Treatment of Gram-positive infections without known susceptibility results.
- Treatment of urinary tract infections or pyelonephritis where culture/susceptibility demonstrates susceptibility to lower tier antimicrobials.

Formulations Available within the OSU Pharmacy

- Zeniquin 25mg tablets
- Zeniquin 50mg tablets
- Zeniquin 100mg tablets
- Zeniquin 200mg tablets

Notes

- Adverse effects are comparable to enrofloxacin. Marbofloxacin should also not be used in young, growing animal due to adverse effects on cartilage.

MEROPENEM [COMPANION]

Restriction Status

Protected

Dose

Species	Usage	Dose
	For multidrug resistant UTIs	8mg/kg SQ q12h (extra-label use)
Cats	**For bacteremia or sepsis**	12-24mg/kg IV q8h or consider CRI due to rapid renal clearance of IV bolus doses (extra-label use)
	For meningitis	12-24mg/kg IV q8h or consider CRI due to rapid renal clearance of IV bolus doses (extra-label use)
	For multidrug resistant UTIs	8mg/kg SQ q12h (extra-label use)
Dogs	**For bacteremia or sepsis**	12-24mg/kg IV q8h or consider CRI due to rapid renal clearance of IV bolus doses (extra-label use)
	For meningitis	12-24mg/kg IV q8h or consider CRI due to rapid renal clearance of IV bolus doses (extra-label use)

Brand Name(s)

Merrem IV®

Background

Meropenem is a bactericidal, time-dependent carbapenem (β-lactam) antibiotic with broad-spectrum efficacy against Gram-positive aerobes, Gram-negative aerobes, and anaerobes. Many *Enterobacteriaceae* that are resistant to other antimicrobials will be susceptible to meropenem; therefore, use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. Carbapenem resistance is a growing problem in human medicine and is expected to become an issue in veterinary medicine with time. Distribution of meropenem throughout the body is wide, and excretion is primarily in urine.

Acceptable Uses

- Treatment of severe infections that are culture-confirmed to be resistant to other

antimicrobial choices. Particularly useful for Gram-negative infections.

Unacceptable Uses

- Empiric treatment, except in cases of sepsis or meningitis with a high index of suspicion for multidrug resistant infections.

Formulations Available within the OSU Pharmacy

- Meropenem 1g/20ml injectable suspension
- Meropenem 500mg/10ml injectable suspension

Notes

- Meropenem use in animals is highly controversial, and should only be considered as a last resort when other antimicrobial treatment options have been ruled out.
- Meropenem is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.

METRONIDAZOLE [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Label dose**	10-15mg/kg PO or IV q12h
	For serious anaerobic infections	25 – 50 mg/kg PO or IV q12h
	For enteritis caused by *Clostridium difficile*	62.5mg/cat PO q12h for 5d
	For metronidazole benzoate	25 mg/kg PO q12h
Dogs	**Label dose**	10-15mg/kg PO q12h

Brand Name(s)

Flagyl®

Background

Metronidazole is a bactericidal, concentration-dependent nitroimidazole antibiotic with a narrow spectrum of activity against anaerobes and protozoa. It is **not effective** against aerobes. It distributes widely throughout the body, including into bone and the central nervous system. Elimination is via hepatic metabolism, and both active drug and inactive metabolites are excreted in urine and feces.

Acceptable Uses

- Treatment of enteric or systemic anaerobic infections, including sepsis with a suspected or culture-confirmed anaerobic component.
- Treatment of giardiasis and other protozoal enteric infections, sometimes used in combination with fenbendazole.
- Surgical prophylaxis against anaerobes, often used in combination with an antimicrobial with aerobic coverage.

Unacceptable Uses

- Aerobic infections.

Formulations Available within the OSU Pharmacy

- Metronidazole 250mg tablets
- Metronidazole 500mg tablets
- Metronidazole 25mg/ml oral suspension
- Metronidazole 50mg/ml oral suspension
- Metronidazole 100mg/ml oral suspension
- Metronidazole 5mg/ml injectable suspension

Notes

- Metronidazole has a bitter taste and owners should be warned about excessive salivation after administration.
- High doses of metronidazole are neurotoxic in dogs and cats, which display central vestibular signs.
- Used to treat giardiasis (at 10-15mg/kg PO q12h) in combination with fenbendazole.

MINOCYCLINE [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**Dosing guidelines in cats are anecdotal**	5mg/kg q12h *or* 10mg/kg q24h PO (extra-label use)
Dogs	**For susceptible pathogens**	5mg/kg q12h *or* 10mg/kg q24h PO (extra-label use)

Brand Name(s)

Minocin®

Background

Minocycline is a bacteriostatic, time-dependent tetracycline antibiotic with a broad spectrum of activity against many Gram-positive aerobes, some Gram-negative aerobes, and some anaerobes such as *Clostridium perfringens* and *Clostridium tetani*. It is **not effective** against *Proteus* spp. or *Pseudomonas* spp. and acquired resistance is widespread in *Enterobacteriaceae*. Intracellular organisms are highly susceptible. Distribution is wide, and minocycline crosses into the prostate and non-inflamed meninges. Minocycline is primarily excreted as inactive metabolites in feces and urine.

Acceptable Uses

- Treatment of some Gram-positive aerobes when susceptibility is confirmed by culture/susceptibility testing.
- Treatment of brucellosis.
- As an alternative to doxycycline.

Unacceptable Uses

- Does not achieve therapeutic concentration in urine and is not useful for urinary tract infections.

Formulations Available within the OSU Pharmacy

- Minocycline 100mg capsule

Notes

- Commercially available minocycline dissociates into minocycline and HCl, which can cause a chemical burn resulting in esophagitis in cats and small dogs. Owners should be warned to follow oral minocycline administration with water or a small amount of food to prevent minocycline becoming lodged in the esophagus.
- GI side effects (i.e. vomiting, diarrhea, and/or anorexia) are common in dogs and cats after administration of minocycline.

NITROFURANTOIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For urinary tract infections**	4.4-5mg/kg PO q8h for 7-14d (extra-label use)
	For prophylaxis	4mg/kg PO q24 (extra-label use)
Dogs	**For urinary tract infections**	4.4-5mg/kg PO q8h for 7-14d (extra-label use)
	For prophylaxis	4mg/kg PO q24 (extra-label use)

Brand Name(s)

Macrodantin®, Macrobid®

Background

Nitrofurantoin is a bacteriostatic nitrofuran antibiotic. It may also be bactericidal depending on concentration achieved and susceptibility of specific organisms. Its pharmacokinetic/pharmacodynamic relationship is poorly understood. It has excellent activity against Gram-positive and Gram-negative aerobes, but it is **not effective** against anaerobes, *Proteus* spp., or *Pseudomonas aeruginosa*. Nitrofurantoin is rapidly eliminated after absorption, and so therefore only achieves therapeutic concentrations in urine, where it is excreted as active drug.

Acceptable Uses

- Treatment of urinary tract infections, particularly those documented to be resistant to first-line antimicrobial choices.
- Prevention of urinary tract infections in patients with documented recurrent urinary tract infections. Use as a preventive can begin after prior treatment with an effective antibiotic at a therapeutic dose and resolution of clinical signs.

Unacceptable Uses

- Treatment of infections other than urinary tract infections.

Formulations Available within the OSU Pharmacy

- Nitrofurantoin 50mg capsule
- Nitrofurantoin 0.2% ointment
- Macrodantin 25mg capsule

Notes

- N/A

PRADOFLOXACIN [COMPANION]

Restriction Status

Selectively Use

Dose

Species	Usage	Dose
Cats	**Label dose**	7.5mg/kg PO q24h for 7d
	For respiratory tract infections	5mg/kg PO q24h for ⩾5d (extra-label use)
	For wounds	5mg/kg PO q24h for 7d (extra-label use)
	For UTIs	5mg/kg PO q24h for 11-30d (extra-label use)
	For bartonellosis	5-10mg/kg PO q12-24h for 28-42d (extra-label use)
	For wounds or systemic infections	3-5mg/kg PO q24h for 7d (extra-label use)
Dogs	**For superficial or deep pyoderma**	3-3.7mg/kg PO q24h to resolution of clinical signs or one week past resolution (extra-label use)
	For UTIs	3mg/kg PO q24h for 7-21d (extra-label use)

Brand Name(s)

Veraflox®

Background

Pradofloxacin is a bactericidal, concentration-dependent fluoroquinolone antibiotic with broad-spectrum activity against Gram-negative aerobes, Gram-positive aerobes, and some anaerobes. It is more efficacious against Gram-positive aerobes and anaerobes compared to other veterinary fluoroquinolones, which are not suitable for treating anaerobic infections. Distribution is wide, including into abscesses, and excretion is primarily as active drug in urine.

Acceptable Uses

- Treatment of skin infections including wounds, abscesses, and pyoderma.
- Treatment of urinary tract infections.

- Treatment of bartonellosis in cats.
- Treatment of upper respiratory tract infections associated with *Mycoplasma* spp. when doxycycline is not effective. Less useful for treatment of *Chlamydophila*.
- Treatment of cholangiohepatitis in cats with neutrophilic hepatic inflammation or evidence of biliary infection.

Unacceptable Uses

- Avoid in dogs when other antimicrobial choices are available.

Formulations Available within the OSU Pharmacy

- Veraflox 25mg/ml oral suspension

Notes

- Pradofloxacin only carries a label for use in cats in the United States, though it is also labelled for use in dogs in the United Kingdom. Adverse effects including development of arrhythmias in dogs with pre-existing risk factors (hypothyroidism, heart failure, kidney disease, etc.) or bone marrow suppression. Since the FDA-approved label for pradofloxacin carries the warning "DO NOT USE IN DOGS," an alternative antimicrobial choice should be sought when possible.
- Pradofloxacin should also not be used in young, growing animal due to adverse effects on cartilage.
- This should be used selectively (i.e. as a second resource drug).

RIFAMPIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	For bartonellosis	5-10mg/kg PO q24 for 14d (can be used up to 20mg/kg) (extra-label use)
Dogs	For pyoderma	10mg/kg PO q24h (extra-label use)
	For bacteremia	10mg/kg IV or IM q12h (extra-label use)
	For brucellosis	5-10mg/kg PO q24h (extra-label use)

Brand Name(s)

Rifampicin®, Rifadin®

Background

Rifampin is a bactericidal, concentration-dependent antibiotic with a narrow spectrum of activity against Gram-positive aerobes such as *Staphylococcus* spp., some non-enteric Gram-negative aerobes such as *Bartonella* or *Brucella*, and most anaerobes. Distribution is wide, including intracellularly, and rifampin remains active in acidic environments such as necrotic tissue. Excretion is not fully understood, but is thought to be primarily in bile.

Acceptable Uses

- Treatment of refractory pyoderma, abscesses, or other soft tissue infections. Particularly useful for methicillin-resistant *Staphylococcus* infections.
- Treatment of osteomyelitis or implant infections, CNS infections, infectious endocarditis, and other hard-to-reach sites. Particularly useful for methicillin-resistant *Staphylococcus* infections.

Unacceptable Uses

- Not for use as a first-line antimicrobial choice. Culture/susceptibility testing are highly

recommended.

Formulations Available within the OSU Pharmacy

- Rifampin 300mg capsule

Notes

- May affect elimination of other hepatically-metabolized drugs (e.g. barbituates).
- Causes orange to red staining of mucous membranes, urine, and other secretions.

TRIMETHOPRIM- OR ORMETOPRIM-SULFONAMIDE COMBINATIONS [COMPANION]

Restriction Status

Unrestricted

Dose

Ormetoprim-Sulfadimethoxine (Primor®)

Species	Usage	Dose
Cats	**Not Applicable**	N/A
Dogs	**Label dose**	55mg/kg PO once followed by 27.5mg/kg PO q24h for no longer than 21d

Trimethoprim-Sulfadiazine or Trimethoprim-Sulfamethoxazole (Tribrissen®)

Species	Usage	Dose
Cats	**For soft tissue infections and uncomplicated UTIs**	15mg/kg PO q12h for 7-14d (extra-label use)
Dogs	**Label dose**	30mg/kg PO q24h *or* 15mg/kg PO q12h
	For systemic infections or bacteremia	30-45mg/kg PO or SQ q12h for 3-5d (extra-label use)

Brand Name(s)

Tribrissen®, Primor®, etc.

Background

Trimethoprim- or ormetoprim-sulfonamides are a group of time-dependent potentiated sulfonamide antibiotics. Sulfonamides are bacteriostatic when used alone, but bactericidal when used in combination with trimethoprim or ormetoprim. They are broadly effective against many Gram-positive and Gram-negative aerobic bacteria, but are **not effective** against *Pseudomonas* spp., *Mycoplasma* spp., and most isolates of *Klebsiella* spp. *In vivo* activity against anaerobes is poor. Distribution is wide,

and therapeutic concentrations can be achieved intracellularly and across the blood-brain barrier. Excretion is primarily as unchanged drug in urine.

Acceptable Uses

- Treatment of many systemic infections including soft tissue and skin infections, pyoderma, urinary tract infections, respiratory tract infections, gastrointestinal infections, etc.

Unacceptable Uses

- Should never be used in black-and-tan dog breeds.

Formulations Available within the OSU Pharmacy

- Sulfamethoxazole/trimethoprim 400/80 tablet
- Sulfamethoxazole/trimethoprim 800/160 tablet
- Primor 600mg tablet

Notes

- Immune-mediated adverse effects such as keratoconjunctivitis sicca, immune-mediated thrombocytopenia, or immune-mediated hemolytic anemia may occur in dogs. Immune-mediated polyarthropathy has been noted in black-and-tan dogs and should therefore not be used in these breeds or mixed-breeds. Obtaining a baseline Schirmer tear test value and weekly monitoring thereafter are recommended to determine if adverse effects are developing. Serial CBC monitoring may also be useful for patients receiving prolonged treatment.
- Leukopenia and anemia are also adverse effects in cats.

TYLOSIN [COMPANION]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Cats	**For upper respiratory tract infection**	6-16mg/kg PO q12h (extra-label use)
	For campylobacteriosis	11mg/kg PO q8h (extra-label use)
	For clostridial diarrhea	20-40mg/kg PO q12-24h for 7-14d (extra-label use)
	For cryptosporidiosis	10-15mg/kg PO q12h (extra-label use)
Dogs	**For upper respiratory tract infection**	6-16mg/kg PO q12h (extra-label use)
	For campylobacteriosis	11mg/kg PO q8h (extra-label use)
	For clostridial diarrhea	20-40mg/kg PO q12-24h for 7-14d (extra-label use)
	For inflammatory bowel disease	12-20mg/kg PO q8-24h (gradually increase dosing interval) (extra-label use)
	For idiopathic antibiotic-responsive diarrhea	6-16mg/kg PO q24h (extra-label use)

Brand Name(s)

Tylan®

Background

Tylosin is a bacteriostatic, time-dependent macrolide antibiotic with good activity against Gram-positive aerobes. There is somewhat less activity against Gram-negative aerobes, but good activity against *Pasteurellaceae*. Tylosin is **not effective** against *Pseudomonas aeruginosa* and most *Enterococcus* spp. Distribution is wide, and excretion is primarily as unchanged drug in bile and urine.

Acceptable Uses

- Treatment of campylobacteriosis, clostridial diarrhea, or cryptosporidioisis.
- Treatment of upper respiratory tract disease associated with *Mycoplasma* or *Chlamydia* spp.

- Control (but not necessarily cure) of inflammatory bowel disease or idiopathic antibiotic-responsive diarrhea.

Unacceptable Uses

- Low doses of tylosin was previously used to prevent or reduce tear-staining (secondary to epiphora). This is now considered irresponsible antimicrobial use and the FDA has removed all tylosin products used solely to treat tear-staining from the market.

Formulations Available within the OSU Pharmacy

- Tylosin 200mg/ml injectable suspension
- Tylan 200mg/ml injectable suspension
- Tylan soluble per gram

Notes

- Erythromycin is used to predict susceptibility.

VANCOMYCIN [COMPANION]

Restriction Status

Protected

Dose

Species	Usage	Dose
Cats	**For life-threatening systemic infections**	15mg/kg IV q6-8h, given slowly (over 30-60min) *or* 3.5mg/kg IV once, followed by 1.5mg/kg/hr CRI (extra-label use)
	For *C. difficile* enteritis	10-20mg/kg PO q6h for 7d (extra-label use)
Dogs	**For life-threatening systemic infections**	15mg/kg IV q6-8h, given slowly (over 30-60min) *or* 3.5mg/kg IV once, followed by 1.5mg/kg/hr CRI (extra-label use)
	For *C. difficile* enteritis	10-20mg/kg PO q6h for 7d (extra-label use)

Brand Name(s)

Vancocin®

Background

Vancomycin is a bactericidal, concentration-dependent glycopeptide antibiotic with a narrow spectrum of activity against Gram-positive aerobes. *Clostridium* spp. are also susceptible. Many *Staphylococcus* spp. and *Enterococcus* spp. that are resistant to other antimicrobials will be susceptible to vancomycin; use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. Vancomycin must be given IV since it is poorly bioavailable; when given PO, vancomycin stays within the gastrointestinal tract. Tissue distribution is poor, and parenterally administered vancomycin is primarily excreted in urine

Acceptable Uses

- Treatment of multidrug resistant, Gram-positive infections causing life-threatening, systemic disease. **Culture and susceptibility must be performed prior to use.**
- Treatment of metronidazole-resistant *Clostridium difficile* enteritis, when given PO. **Culture and susceptibility must be performed prior to use.**

Unacceptable Uses

- Empiric use.

Formulations Available within the OSU Pharmacy

- Vancomycin 500mg/10ml injectable suspension

Notes

- Vancomycin use in animals is highly controversial, and should only be considered as a last resort when other antimicrobial treatment options have been ruled out.
- Vancomycin is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.

SELECTED ANTIMICROBIAL INFORMATION - EQUINE

AMIKACIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections or empirical therapy**	• Adults: 10mg/kg IV q24h (extra-label use) • Foals: 20-25mg/kg IV q24h (extra-label use)
	For septic arthritis	20mg/kg IV q24h (extra-label use)
	For regional limb perfusion	500mg to 2g in perfusate (variable volume) (extra-label use)
	For uterine infusion	2g mixed with 200mL sterile 0.9% saline; infused into the uterus q24h for three day (extra-label use)

Brand Name(s)

Amikin®, Amiglyde-V®

Background

Amikacin is a bactericidal, concentration-dependent aminoglycoside antibiotic with efficacy primarily against Gram-negative aerobic organisms and somewhat less efficacy against Gram-positive aerobes such as *Staphylococcus* spp. Amikacin is **not effective** against anaerobic bacteria and often not efficacious against *Streptococcus* spp. Distribution is throughout the extracellular fluid, and penetration into cells and tissues is poor. Excretion is primarily in urine. There is a significant post-antibiotic effect.

Acceptable Uses

- When used in combination with a β-lactam, provides broad-spectrum coverage for treatment of pleuropneumonia, septic arthritis, or osteomyelitis.
- Treatment of septic arthritis or other localized infections when used in antibiotic-impregnated polymethylacrylate beads, intra-articular injections, or regional limb perfusion.
- Treatment of Gram-negative neonatal sepsis.

- Treatment of metritis when used as a uterine infusion.
- As an alternative to gentamicin.

Unacceptable Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).
- Treatment of many Gram-positive infections, unless culture-confirmed susceptible *Staphylococcus* spp. identified.

Formulations Available within the OSU Pharmacy

- Amikacin 1% topical
- Amikacin 250mg/ml injectable suspension
- Amiglyde 50mg/ml intrauterine solution

Notes

- Nephrotoxicity (acute tubular nephrosis) is a significant side effect that can be avoided by following dosing recommendations, minimizing duration of therapy, maintaining hydration status of patient, minimizing concurrent use of nephrotoxic drugs, and seeking alternative antimicrobial treatment in patients with pre-existing renal disease. Therapeutic drug monitoring can help optimize dosing and minimize trough concentration.

AMPICILLIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of streptococcal lower airway infections or neonatal sepsis.**	• Adults: 15-40mg/kg IV q6h (extra-label use) • Foals: 20-40mg/kg IV q6 (extra-label use)

Brand Name(s)

Polyflex®

Background

Ampicillin is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin, though with somewhat less activity against Gram-positive organisms. Ampicillin distributes widely through the plasma and can cross the blood-brain barrier when meninges are inflamed. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily in urine.

Acceptable Uses

- When used in combination with amikacin (an aminoglycoside), for treatment of neonatal sepsis.
- For treatment of streptococcal lower airway infections.
- Can be used as IV an alternative to penicillin in most cases.

Unacceptable Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).
- Empirical treatment of suspected staphylococcal infections.

- In combination with a bacteriostatic antimicrobial, efficacy is decreased.

Formulations Available within the OSU Pharmacy

- Ampicillin 1g/vial injectable suspension
- Ampicillin 500mg/vial injectable suspension
- Ampicillin Na 1g/vial injectable suspension
- Ampicillin Na 500mg/vial injectable suspension

Notes

- Ampicillin trihydrate (Polyflex®) should not be given IV due to risk of anaphylaxis and sudden death. Ampicillin sodium is safe for IV injection.

AZITHROMYCIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of *Rhodococcus equi***	10mg/kg PO q24h; q48h treatment can be initiated after the first 5d of treatment (extra-label use)

Brand Name(s)

Zithromax®

Background

Azithromycin is a bacteriostatic, time-dependent macrolide antibiotic with broad-spectrum activity against Gram-positive aerobes and some Gram-negative aerobes, such as the *Pasteurellaceae*. Azithromycin is **not effective** against *Pseudomonas aeruginosa*, and many *Enterobacteriaceae* have acquired resistance. Azithromycin is bactericidal against *Streptococcus* spp. It is widely distributed and can be used to treat intracellular organisms and in the presence of necrotic tissue. Excretion is primarily in bile.

Acceptable Uses

- Used in combination with rifampin for treatment of *Rhodococcus equi* pneumonia in foals.
- Used in combination with rifampin for treatment of *Streptococcus zooepidemicus* pneumonia.
- For treatment of internal abscesses.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Azithromycin 20mg/ml oral suspension

- Azithromycin 250mg tablet

Notes

- Severe and fatal colitis has been associated with macrolide use in adult horses and thus should be avoided in adults. Foals receiving treatment with a macrolide antibiotic should have their mouths rinsed out after to administration to prevent adverse effects to the mare.
- Macrolides have been associated with significant hyperthermia in treated foals due to off-target effects on apocrine sweat glands; treated foals should not be housed in direct sunlight for prolonged periods of time and should have access to a climate-controlled enclosure.

CEFAZOLIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections**	• Adults: 10-20mg/kg IV q6-8h (extra-label use) • Foals: 15-20mg/kg IV q8-12h (extra-label use)

Brand Name(s)

Ancef®, Kefzol®, Zolicef®

Background

Cefazolin is a bactericidal, time-dependent first generation cephalosporin (β-lactam) antibiotic with activity primarily against Gram-positive aerobes, and more limited activity against Gram-negative aerobes and anaerobes. Cefazolin is **often not effective** against *Rhodococcus equi* and is also **not effective** against *Enterococcus* spp., and *Pseudomonas aeruginosa*. Distribution throughout the body is wide, but cefazolin does not penetrate intracellularly or cross the blood-brain barrier. Excretion is primarily in urine.

Acceptable Uses

- Treatment of infections caused by culture-confirmed susceptible *Staphylococcus* spp.

Unacceptable Uses

- Should not be used as a first-line treatment for suspected Gram-negative infections.

Formulations Available within the OSU Pharmacy

- Cefazolin 1g/10ml injectable suspension

Notes

- None

CEFOTAXIME [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
	For susceptible infections in neonatal foals	20-40mg/kg IV q6-12h (extra-label use)
Horses	**For meningitis in neonatal foals**	40mg/kg IV q6h (extra-label use)
	For regional limb perfusion in foals	1g per 20mL 0.9% NaCl for 20min (extra-label use)

Brand Name(s)

Claforan®

Background

Cefotaxime is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with increased activity against Gram-negative bacteria such as *Enterobacteriaceae* when compared to first and second generation cephalosporins (e.g. cefazolin). It is **not effective** against *Enterococcus* spp. and *Pseudomonas aeruginosa*, and has less efficacy against anaerobes than second generation cephalosporins. Distribution throughout the body is wide, and cefotaxime crosses the blood-brain barrier. Excretion is primarily in urine.

Acceptable Uses

- Empirical treatment of sepsis or meningitis in neonatal foals; culture/susceptibility should be performed to further guide treatment.
- Treatment of susceptible septic arthritis in foals.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cefotaxime 10g/100ml injectable suspension

Notes

- None.

CEFPODOXIME [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections in neonatal foals**	10mg/kg PO q6-12h (extra-label use)

Brand Name(s)

Simplicef®, Vantin®

Background

Cefpodoxime is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with excellent activity against Gram-negative bacteria such as *Enterobacteriaceae*. It is **not effective** against *Enterococcus* spp. or *Pseudomonas aeruginosa*. Distribution throughout the body is wide, but cefpodoxime does not penetrate intracellularly or cross the blood-brain barrier. Excretion is primarily in urine.

Acceptable Uses

- Oral alternative to cefotaxime for treatment of sepsis in neonatal foals; culture/susceptibility should be performed to further guide treatment.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Cefpodoxime 100mg tablet
- Cefpodoxime 200mg tablet

Notes

- None.

CEFTIOFUR [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**Ceftiofur sodium (Naxcel®)**	• Adults: 2.2-4.4mg/kg IM q24h (not exceeding 10d of treatment) • Foals: 10mg/kg IM, IV, or SQ q6-12h (extra-label use) • AS CRI: 2.2mg/kg IV once, followed by 12 mcg/kg/min
	Ceftiofur crystalline free acid (Excede®)	For *Streptococcus zooepidemicus*: 6.6mg/kg IM at 0 and 96h

Brand Name(s)

Excede®, Naxcel®

Background

Ceftiofur is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with a broad spectrum of activity against Gram-positive aerobes, Gram-negative aerobes including *Enterobacteriaceae*, and anaerobes including *Clostridium* spp. and *Fusobacterium* spp. It is **not effective** against *Enterococcus* spp. and *Pseudomonas aeruginosa*. Distribution throughout the body is wide, and includes penetration into joints and synovial fluid. Excretion is primarily in urine.

Acceptable Uses

- Treatment of respiratory infections caused by β-hemolytic streptococcal infections.
- Treatment of some abscesses, skin infections, or joint infections.
- Treatment of urinary tract infections.
- When used in combination with an aminoglycoside, can treat mixed infections where greater coverage against Gram-negative bacteria is required (sepsis, peritonitis, cholangiohepatitis, septic arthritis).

- Used in regional limb perfusion or intra-articular injection for treatment of septic arthritis.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Excede 200mg/ml injectable suspension

Notes

- A maximum of 10mL of Naxcel® or 20mL of Excede® should be given per injection site.

CHLORAMPHENICOL [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections**	• 45-60mg/kg PO q6-8h (extra-label use) • 25mg/kg IM or IV q6-8h (extra-label use)
	For foals	20-40mg/kg PO or IV q-64h

Brand Name(s)

Chloromycetin®

Background

Chloramphenicol is a bacteriostatic, time-dependent acetamide antibiotic with a very broad spectrum of activity, including Gram-positive and Gram-negative aerobes, and anaerobes. Plasmid-mediated resistance to chloramphenicol develops in Gram-negative bacteria over time. Chloramphenicol is widely distributed throughout the body, crosses the blood-brain barrier, and penetrates necrotic tissues and abscesses. Elimination is through hepatic metabolism, and inactive metabolites are excreted in urine.

Acceptable Uses

- Treatment of conditions in which broad-spectrum coverage is required (e.g. pneumonia, peritonitis, internal abscesses, cellulitis). Culture and susceptibility are indicated prior to initiating therapy.
- Treatment of central nervous system infections (e.g. meningitis or cerebral abscesses).
- Treatment of proliferative enteropathy in foals caused by *Lawsonia intracellularis*.

Unacceptable Uses

- *Mycobacterium* spp. are intrinsically resistant.

Formulations Available within the OSU Pharmacy

- Chloramphenicol 1g tablet
- Chloramphenicol 250mg tablet

Notes

- Idiosyncratic, irreversible aplastic anemia is a rare complication of human exposure to chloramphenicol, which can lead to death. **Gloves should always be worn when handling chloramphenicol**.
- Chloramphenicol can decrease the clearance of other hepatically-metabolized drugs (e.g. barbiturates, xylazine).

CLARITHROMYCIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of *Rhodococcus equi* in foals**	5mg/kg PO q12h (extra-label use)
	For treatment of *Lawsonia intracellularis* in foals	7.5mg/kg PO q12h (extra-label use)

Brand Name(s)

Biaxin®

Background

Clarithromycin is a bacteriostatic, time-dependent macrolide antibiotic with broad-spectrum activity against Gram-positive aerobes and some Gram-negative aerobes, such as the *Pasteurellaceae*. Clarithromycin is **not effective** against *Pseudomonas aeruginosa*, and many *Enterobacteriaceae* have acquired resistance. Clarithromycin is bactericidal against *Streptococcus* spp. It is widely distributed, including into abscesses, and can be used to treat intracellular organisms. Excretion is primarily in bile.

Acceptable Uses

- Used in combination with rifampin for treatment of *Rhodococcus equi* pneumonia in foals.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Clarithromycin 500mg tablet

Notes

- Severe and fatal colitis has been associated with macrolide use in adult horses and thus should be avoided in adults. Foals receiving treatment with a macrolide antibiotic should have their mouths rinsed out after to administration to prevent adverse effects to the mare.
- Macrolides have been associated with significant hyperthermia in treated foals due to off-target effects on apocrine sweat glands; treated foals should not be housed in direct sunlight for prolonged periods of time and should have access to a climate-controlled enclosure.

DOXYCYCLINE [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of Lyme disease**	10mg/kg PO q12h for 1-2mos
	For treatment of anaplasmosis	10mg/kg PO q12h for10-14d
	For treatment of organisms with MIC ⩽ 0.25mcg/mL	10mg/kg PO q24h
	For treatment of organisms with MIC 0.5-1.0mcg/mL	10mg/kg PO q12h

Brand Name(s)

Vibramycin®

Background

Doxycycline is a bacteriostatic, time-dependent tetracycline antibiotic with a broad spectrum of activity against many Gram-positive and Gram-negative aerobes. It is **not effective** against *Proteus* spp. or *Pseudomonas* spp. There is activity against some anaerobes, but efficacy against *Clostridium* spp. is variable. Intracellular organisms are highly susceptible. Distribution is wide, and it is the only tetracycline that effectively crosses the blood-brain barrier. Doxycycline is primarily excreted in feces.

Acceptable Uses

- As an oral alternative to oxytetracycline for the treatment of anaplasmosis, Potomac Horse Fever, Lyme Disease, or leptospirosis.
- As an alternative therapy for lower respiratory disease in foals caused by β-hemolytic *Streptococcus* spp. or *Rhodococcus equi*.

Unacceptable Uses

- Should never be given IV.

Formulations Available within the OSU Pharmacy

- Doxycycline 50mg capsule
- Doxycycline 100mg capsule
- Doxycycline 20mg tablet
- Doxycycline 100mg tablet
- Vibramycin 10mg/ml oral suspension
- Vibramycin 50mg/5ml syrup

Notes

- Bioavailability of doxycycline is greater in foals than adult horses; doses exceeding 10mg/kg should only be used in adult horses, and there is increased risk of diarrhea with increasing dose.
- Doxycycline **should not be given parenterally** to horses because of unknown safety.

ENROFLOXACIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of susceptible infections**	• 5mg/kg IV q24h (extra-label use) • 5-7.5mg/kg PO q24h (extra-label use)

Brand Name(s)

Baytril®

Background

Enrofloxacin is a bactericidal, concentration-dependent fluoroquinolone antibiotic with activity primarily against Gram-negative aerobes, such as *Enterobacteriaceae* and *Pseudomonas aeruginosa*. Gram-positive coverage is limited, though enrofloxacin is efficacious against many *Staphylococcus* spp. Distribution is wide, including into abscesses, and excretion is primarily in the urine with also a lesser component of biliary excretion.

Acceptable Uses

- Treatment of Gram-negative infections, or when combined with a β-lactam antibiotic, broad spectrum antimicrobial coverage. This includes Gram-negative pneumonia, osteomyelitis, or septic arthritis.
- Treatment of intracellular infections, such as *Mycoplasma*, *Neorickettsia*, or *Anaplasma*.
- Treatment of internal abscesses, such as *Corynebacterium pseudotuberculosis* infections.
- Treatment of urinary tract infections.

Unacceptable Uses

- Gram-positive infections other than susceptible *Staphylococcus* spp.

- Anaerobic infections.
- Should not be used in foals due to risk of articular cartilage damage.

Formulations Available within the OSU Pharmacy

- Enrofloxacin 100mg/ml injectable suspension
- Enrofloxacin 20mg/ml oral suspension
- Enrofloxacin 22.7mg tablet
- Enrofloxacin 68mg tablet
- Enrofloxacin 136mg tablet
- Baytril 22.7mg/ml injectable suspension
- Baytril 100mg/ml injectable suspension
- Baytril 22.7mg tablet
- Baytril 68mg tablet

Notes

- Formulations given PO have been associated with oral ulceration and/or colitis.
- Ciprofloxacin has been associated with fatal colitis in horses and should not be used.

ERYTHROMYCIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of *Rhodococcus equi* in foals**	20-25mg/kg PO q8h (extra-label use)
	For treatment of *Lawsonia intracellularis* in foals	25mg/kg PO q6-8h (extra-label use) 10mg/kg PO q12h when used with rifampin (extra-label use)

Brand Name(s)

Gallimycin®

Background

Erythromycin is a concentration-dependent, primarily bacteriostatic macrolide antibiotic. It may be bactericidal at high doses. Erythromycin is active against Gram-positive aerobes. There is also some efficacy against non-enteric Gram-negatives such as *Actinobacillus* spp. and *Pasteurella* spp., and anaerobes such as *Clostridium* spp. and *Fusobacterium* spp. Distribution throughout the body is wide, and excretion is primarily in bile. .

Acceptable Uses

- Treatment of *Rhodococcus equi* pneumonia in foals when used in combination with rifampin.
- Treatment of *Lawsonia intracellularis* (equine proliferative enteropathy) in foal; used with or without rifampin.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Currently no oral erythromycin formulations available within the OSU pharmacy; available

upon request

Notes

- Severe and fatal colitis has been associated with macrolide use in adult horses and thus should be avoided in adults. Foals receiving treatment with a macrolide antibiotic should have their mouths rinsed out after to administration to prevent adverse effects to the mare.
- Macrolides have been associated with significant hyperthermia in treated foals due to off-target effects on apocrine sweat glands; treated foals should not be housed in direct sunlight for prolonged periods of time and should have access to a climate-controlled enclosure.

GENTAMICIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections in adult horses**	6.6mg/kg IV q24h (extra-label use)
	For susceptible infections in foals <2wks	12mg/kg IV q36h (extra-label use)
	For susceptible infections in foals >2wks	6.6mg/kg IV q24h (extra-label use)
	For susceptible uterine infections	2.0-2.5g diluted in 200-500mL sterile 0.9% NaCl, infused into the uterus q24h for 3-5d during estrus
	For regional limb perfusion	1g or 1/3 the systemic dose diluted to 30-60 ml with sterile 0.9% saline

Brand Name(s)

Gentocin®, Garamycin®

Background

Gentamicin is a bactericidal, concentration-dependent aminoglycoside antibiotic with efficacy primarily against Gram-negative aerobic organisms, and some Gram-positive aerobes such as *Staphylococcus* spp. Gentamicin is **not effective** against anaerobic bacteria. Distribution is throughout the extracellular fluid, and penetration into cells and tissues is poor. Excretion is primarily in urine. There is a significant post-antibiotic effect.

Acceptable Uses

- Used in combination with a β-lactam, provides broad-spectrum coverage for treatment of pleuropneumonia, septic arthritis, or osteomyelitis.
- Treatment of streptococcal and non-enteric Gram-negative infections, including *Pseudomonas aeruginosa*.
- Treatment of septic arthritis or other localized infections when used in antibiotic-

impregnated polymethylacrylate beads, intra-articular injections, or regional limb perfusion.

- As an alternative to amikacin.

Unacceptable Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).
- Anaerobic infections.

Formulations Available within the OSU Pharmacy

- Gentamicin 100mg/ml injectable suspension
- Gentamicin Sulfate 100mg/ml intrauterine infusion suspension

Notes

- Nephrotoxicity (acute tubular nephrosis) is a significant side effect that can be avoided by following dosing recommendations, minimizing duration of therapy, maintaining hydration status of patient, minimizing concurrent use of nephrotoxic drugs, and seeking alternative antimicrobial treatment in patients with pre-existing renal disease. Therapeutic drug monitoring can help optimize dosing and minimize trough concentration to help avoid nephrotoxicity.

IMIPENEM [EQUINE]

Restriction Status

Protected

Dose

Species	Usage	Dose
Horses	**For susceptible infections**	25mg/kg IV q6h (extra-label use)
	For regional limb perfusion	500 mg diluted to 100 mL with 0.9% sterile sodium chloride solution

Brand Name(s)

Primaxin®

Background

Imipenem is a primarily bactericidal, time-dependent carbapenem (β-lactam) antibiotic with broad-spectrum efficacy against Gram-positive aerobes, Gram-negative aerobes, and anaerobes. Many *Enterobacteriaceae* that are resistant to other antimicrobials will be susceptible to meropenem; therefore, use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. Carbapenem resistance is a growing problem in human medicine and is expected to become an issue in veterinary medicine with time. Imipenem is formulated with cilastatin, which slows the metabolism of imipenem. Distribution throughout the body is wide, and excretion is primarily in urine.

Acceptable Uses

- Treatment of neonatal sepsis caused by organisms resistant to other antimicrobials.
- When given as a CRI, treatment of synovial infections.
- Regional limb perfusion when indicated by culture and susceptibility

Unacceptable Uses

- Empirical treatment.

Formulations Available within the OSU Pharmacy

- There are currently no formulations of imipenem available at the OSU pharmacy; available upon request

Notes

- Imipenem use in animals is highly controversial and should only be considered as a last resort when all other antimicrobial treatment options have been ruled out.
- Imipenem is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing for any purpose.****EXCEPTION: Use of this antibiotic does NOT need prior approval when used for regional limb perfusion at the above dose.

MEROPENEM [EQUINE]

Restriction Status

Protected

Dose

Use of this drug should be based on culture and sensitivity in consultation with the clinical microbiologist.

Brand Name(s)

Merrem® IV

Background

Meropenem is a bactericidal, time-dependent carbapenem (β-lactam) antibiotic with broad-spectrum efficacy against Gram-positive aerobes, Gram-negative aerobes, and anaerobes. Many *Enterobacteriaceae* that are resistant to other antimicrobials will be susceptible to meropenem; therefore, use should be strictly reserved for infections caused by organisms that are resistant to other antimicrobial choices. Carbapenem resistance is a growing problem in human medicine and is expected to become an issue in veterinary medicine with time. Distribution of meropenem throughout the body is wide, and excretion is primarily in urine.

Acceptable Uses

- N/A

Unacceptable Uses

- Empirical treatment

Formulations Available within the OSU Pharmacy

- Meropenem 1g/20ml injectable suspension
- Meropenem 500mg/10ml injectable suspension

Notes

- Meropenem use in animals is highly controversial and should only be considered as a last resort when all other antimicrobial treatment options have been ruled out.
- Meropenem is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.

METRONIDAZOLE [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	For susceptible infections	• 15-25mg/kg PO q6-8h (extra-label use) • 10mg/kg IV q6-8h (extra-label use)
	For clostridial enterocolitis in foals	15mg/kg PO q8-12h; lower doses (10mg/kg PO or IV q12h) recommended for neonates (<14d old) (extra-label use)

Brand Name(s)

Flagyl®

Background

Metronidazole is a bactericidal, concentration-dependent nitroimidazole antibiotic with a narrow spectrum of activity against anaerobes and also protozoa. It distributes widely through the body, including into the central nervous system. Elimination is via hepatic metabolism, and inactive metabolites are excreted in the urine.

Acceptable Uses

- Treatment of clostridial myositis/myonecrosis.
- Treatment of clostridial enterocolitis.
- As part of broad-spectrum coverage for treatment of polymicrobial infections with a suspected or culture-confirmed anaerobic component, such as pleuropneumonia or metritis.
- Topical treatment of thrush (*Fusobacterium necrophorum*).

Unacceptable Uses

- Aerobic infections.

Formulations Available within the OSU Pharmacy

- Metronidazole 250mg tablets
- Metronidazole 500mg tablets
- Metronidazole 25mg/ml oral suspension
- Metronidazole 50mg/ml oral suspension
- Metronidazole 100mg/ml oral suspension
- Metronidazole 5mg/ml injectable suspension

Notes

- Higher doses have occasionally been linked to anorexia, ataxia, and depression.

OXYTETRACYCLINE [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of anaplasmosis**	6.6mg/kg IV q24h for 5-7d, diluted and given slowly (extra-label use)
	For treatment of Potomac Horse Fever	6mg/kg IV q12-24h for up to 5d, diluted and given slowly (extra-label use)
	For treatment of Lyme disease	6.6mg/kg IV q12h for 7-10d, diluted and given slowly (to be followed by treatment with doxycycline for 1-2mos.)(extra-label use)
	For treatment of proliferative enteropathy	6mg/kg IV q12-24h for 2-4wks, diluted and given slowly (extra-label use)

Brand Name(s)

Biomycin®, Terramycin®

Background

Oxytetracycline is a bacteriostatic, time-dependent tetracycline antibiotic with a broad spectrum of activity against many Gram-positive and Gram-negative aerobes. It is **not effective** against *Proteus* spp. or *Pseudomonas* spp. There is activity against some anaerobes, but efficacy against *Clostridium* spp. is variable. Intracellular organisms are highly susceptible. Distribution is wide, except to the central nervous system. Oxytetracycline undergoes entero-hepatic recycling and is primarily excreted in urine.

Acceptable Uses

- Treatment of anaplasmosis (*Anaplasma phagocytophilum*), Potomac Horse Fever (*Neorickettsia risticii*), and Lyme Disease (*Borrelia burgdorferi*).
- Treatment of proliferative enteropathy in foals caused by *Lawsonia intracellularis*.

Unacceptable Uses

- N/A

Formulations Available within the OSU Pharmacy

- Oxytetra 100mg/ml injectable suspension
- Oxytetra 200 mg/ml injectable suspension

Notes

- Oxytetracycline has poor oral bioavailability.
- Rapid IV administration can result in hypotension and collapse or renal tubular necrosis.
- Oxytetracycline is also used for the treatment of flexural limb deformity in foals due to its non-antimicrobial effects, including attenuation of matrix metalloprotease activity, anti-fibrotic effects, anti-collagenase effects, and anti-inflammatory effects.

PENICILLIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For susceptible infections (Sodium penicillin G, potassium penicillin G)**	22,000-44,000 IU/kg IV q6h, given slowly
	For susceptible infections (Procaine penicillin G)	22,000 IU/kg IM q12h

Brand Name(s)

sodium penicillin G, potassium penicillin G, procaine penicillin G; penicillin V potassium

Background

Penicillin G is a bactericidal, time-dependent β-lactam antibiotic with good activity against many Gram-positive organisms, though it is **not effective** against β-lactamase-producing *Staphylococcus* spp., α-*Streptococcus* spp., *or Rhodococcus equi*. It has limited efficacy against Gram-negative bacteria. Penicillin G distributes widely through the plasma but has low lipid solubility and does not penetrate abscesses or sites of tissue necrosis well. The active form of penicillin G is excreted in high concentration in the urine.

Acceptable Uses

- First line choice for treatment of streptococcal infections such as *Streptococcus equi* (strangles), or *Streptococcus zooepidemicus* (upper and lower respiratory infection).
- Treatment of clostridial infections such as clostridial myositis, botulism, or tetanus.
- Treatment of susceptible urinary tract infections.
- When used in combination with gentamicin, a first line choice for broad-spectrum therapy (as in cases of peritonitis, pleuropneumonia, cholangiohepatitis, sepsis, or endocarditis).
- Treatment of orthopedic infections (osteomyelitis, septic arthritis) when β-lactamase-producing *Staphylococcus* spp. or *Enterobacteriaceae* have been ruled out by culture.

Unacceptable Uses

- Treatment of suspected or cultured-confirmed *Enterobacteriaceae* infections.
- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).
- Empirical treatment of suspected staphylococcal infections.
- In combination with a bacteriostatic antimicrobial, efficacy is decreased.

Formulations Available within the OSU Pharmacy

- Penicillin gel 5ml/syringe
- Penicillin gel 10ml/syringe
- Penicillin G Potassium 20mmu injectable suspension
- Penicillin G Procaine injectable suspension (1 ml, 30 ml, 100 ml, 250 ml)

Notes

- Intravascular injection of procaine penicillin G can cause excitement, seizure-like activity, and death. **Procaine penicillin G should be given IM only**.
- Rapid IV administration of potassium penicillin can cause head shaking/lip smacking, salivation, lacrimation, increased borborygmi, colic, agitation, and soft to liquid feces. Potassium penicillin should be given over 5 minutes.

RIFAMPIN [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of *Rhodococcus equi***	5mg/kg PO q12h (to be used in combination with a macrolide antibiotic) (extra-label use)
	For treatment of susceptible infections	10mg/kg PO q24h (to be used in combination with another antibiotic) (extra-label use)

Brand Name(s)

Rifampicin®

Background

Rifampin is a bactericidal, concentration-dependent antibiotic with a narrow spectrum of activity against Gram-positive aerobes, some non-enteric Gram-negative aerobes, and most anaerobes. Distribution is wide, including intracellularly, and rifampin remains active in acidic environments such as necrotic tissue. Excretion is not fully understood, but is thought to be primarily in bile.

Acceptable Uses

- Used in combination with a macrolide, for treatment of *Rhodococcus equi* pneumonia in foals.
- Used in combination with penicillin, ceftiofur, or potentiated sulfonamides, for treatment of internal abscesses caused by *Corynebacterium* spp. or *Streptococcus* spp.
- Treatment of mycobacterial infections.
- Treatment of penicillinase-producing *Staphylococcus aureus* infections.

Unacceptable Uses

- Rifampin should **never** be used as the sole antimicrobial for treating a patient due to rapid development of resistance; it should always be used in conjunction with another antibiotic.

- Antagonized by concurrent use of fluoroquinolones.

Formulations Available within the OSU Pharmacy

- Rifampin 300mg capsule

Notes

- May affect elimination of other hepatically-metabolized drugs (e.g. barbiturates, xylazine).
- Causes orange to red staining of urine, mucous membranes, and other secretions.

TRIMETHOPRIM-SULFONAMIDE COMBINATIONS [EQUINE]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Horses	**For treatment of susceptible infections**	15-20mg/kg PO q12h
	For treatment of lower respiratory tract infections cause by susceptible *Streptococcus equi* subsp. *Zooepidemicus*	15-20mg/kg PO q12h for 10d

Brand Name(s)

trimethoprim-sulfadiazine = Tribrissen®, trimethoprim-sulfamethoxazole = Bactrim®, Sulfatrim®, Bactrim DS®

Background

Trimethoprim-sulfonamides are a group of time-dependent potentiated sulfonamide antibiotics. Sulfonamides are bacteriostatic when used alone, but bactericidal when used in combination with trimethoprim. They are broadly effective against many Gram-positive and Gram-negative aerobic bacteria, but are **not effective** against *Pseudomonas* spp., *Mycoplasma* spp., and most isolates of *Klebsiella* spp. *In vivo* activity against anaerobes is poor. Distribution is wide, and therapeutic concentrations can be achieved intracellularly and across the blood-brain barrier. Excretion is primarily in urine.

Acceptable Uses

- Treatment of respiratory infections, septic arthritis, osteomyelitis, peritonitis, or meningitis. Culture/susceptibility are highly recommended to further guide treatment due to widespread resistance.
- In combination with rifampin, for treatment of internal abscesses (despite poor penetration of purulent material when used alone).

- Treatment of urinary tract infections.
- Treatment of placentitis, retained fetal membranes, or epididymitis.

Unacceptable Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses); recommended to use in combination with debridement or flushing.

Formulations Available within the OSU Pharmacy

- Sulfamethoxazole/trimethoprim 400/80 tablet
- Sulfamethoxazole/trimethoprim 800/160 tablet

Notes

- Oral absorption may be decreased when given with food.

VANCOMYCIN [EQUINE]

Restriction Status

Protected

Dose

Species	Usage	Dose
Horses	**For susceptible, Gram-positive, systemic infections**	7.5mg/kg IV q8h, given over 30 min (extra-label use)
	For regional limb perfusion	300mg diluted into 60mL 0.9% saline and given as an IV or IO infusion over 30min (extra-label use)

Brand Name(s)

Vancocin®

Background

Vancomycin is a bactericidal, concentration-dependent glycopeptide antibiotic with a narrow spectrum of activity against Gram-positive aerobes. *Clostridium* spp. are also susceptible. Many *Staphylococcus* spp. and *Enterococcus* spp. that are resistant to other antimicrobials will be susceptible to vancomycin; use should be strictly reserved for infections caused by organisms that are resistant to all other antimicrobial choices. Tissue distribution is poor, and vancomycin must be given IV since it is poorly bioavailable; when given PO, vancomycin tends to stay within the gastrointestinal tract. Vancomycin is excreted primarily in urine.

Acceptable Uses

- Treatment of multidrug resistant, Gram-positive infections causing life-threatening, systemic disease. Culture and susceptibility must be performed prior to use.
- Treatment of metronidazole-resistant *Clostridium difficile* enteritis, when given PO. Culture and susceptibility must be performed prior to use.

Unacceptable Uses

- Empiric use.

Formulations Available within the OSU Pharmacy

- Vancomycin 500mg/10ml injectable suspension

Notes

- Vancomycin use in animals is highly controversial and should only be considered as a last resort when all other antimicrobial treatment options have been ruled out.
- Vancomycin is on the **protected antimicrobial** list for the OSU-VMC, and approval must be obtained from the Antimicrobial Stewardship Working Group prior to prescribing.

SELECTED ANTIMICROBIAL INFORMATION - FARM ANIMAL

AMOXICILLIN-CLAVULANIC ACID [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**Label dose**	No labeled dose.
Cattle	**Label dose**	No labeled dose.
Small Ruminants	**Label dose**	No labeled dose.
Swine	**Label dose**	No labeled dose.

Brand Name(s)

Clavamox®

Background

Amoxicillin-clavulanic acid is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin. The addition of clavulanic-acid improves activity against β-lactamase-producing bacteria. Activity against Gram-positive organisms is comparable to amoxicillin and ampicillin. Amoxicillin-clavulanic acid distributes widely through the plasma, and can cross the blood-brain barrier when meninges are inflamed although it is uncertain if therapeutic concentrations are achieved. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily as unchanged drug in urine.

Current Uses within OSU-VMC

- Susceptible pathogens

Contraindicated Uses

- May not be practical to use in large animals due to cost.

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Clavamox 62.5mg/ml oral suspension (15 ml bottle)
- Clavamox 62.5mg tablet
- Clavamox 125mg tablet
- Clavamox 250mg tablet
- Clavamox 375mg tablet

Notes

- None.

AMPICILLIN [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**For Listeriosis**	10-20mg/kg SQ, IV, or IM q12h, can dose up to q8h for listeriosis (extra-label)
Cattle	**Label dose**	4.4-11mg/kg IM q24h, for up to 7d
	For respiratory infections	22mg/kg SQ q12h (extra-label)
Small Ruminants	**For Listeriosis**	10-20mg/kg IV or IM q12h (extra-label)
Swine	**Label dose**	22mg/kg SQ q12h

Brand Name(s)

Polyflex®

Background

Ampicillin is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin, though with somewhat less activity against Gram-positive organisms. Culture/susceptibility are recommended since resistance is widespread amongst *Staphylococcus* spp and many other pathogens. Ampicillin distributes widely through the plasma, and can cross the blood brain barrier when meninges are inflamed. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily in the urine.

Current Uses within OSU-VMC

- Treatment of bovine respiratory disease associated with *Aerobacter* spp., *Klebsiella* spp., *Pasteurella multocida,* or *Escherichia coli*.
- Treatment of swine respiratory infections associated with *Pasteurella* spp.
- Treatment of swine colibacillosis (*Escherichia coli* enteritis).

- Treatment of Listeriosis in camelids and small ruminants.

Contraindicated Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Ampicillin 1g/vial injectable suspension
- Ampicillin 500mg/vial injectable suspension
- Ampicillin NA 1g/vial injectable suspension
- Ampicillin NA 500mg/vial injectable suspension

Notes

- Culture and susceptibility recommended prior to treatment of suspected staphylococcal infections due to widespread resistance.
- Ampicillin trihydrate (Polyflex®) should not be given IV due to risk of anaphylaxis and sudden death. Ampicillin sodium is safe for IV injection.

AMPICILLIN-SULBACTAM [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**Label dose**	No labeled dose.
Cattle	**Label dose**	No labeled dose.
Small Ruminants	**Label dose**	No labeled dose.
Swine	**Label dose**	No labeled dose.

Brand Name(s)

Unasyn®

Background

Ampicillin sodium-sulbactam sodium is a bactericidal, time-dependent β-lactam antibiotic with improved activity against Gram-negative organisms when compared to penicillin. The addition of sulbactam improves activity against β-lactamase-producing bacteria, such as *Staphylococcus* spp., though clavulanic acid is a more potent β-lactamase inhibitor. Activity against Gram-positive organisms is comparable to amoxicillin and ampicillin. Ampicillin-sulbactam distributes widely through the plasma, including into peritoneal and interstitial fluid. It does not penetrate abscesses or sites of tissue necrosis well. Excretion is primarily in urine.

Current Uses within OSU-VMC

- No labeled indications for food animals.

Contraindicated Uses

- None

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Ampicillin/Sulbactam 1.5g (Ampicillin 1g/Sulbactam 0.5g)/vial injectable suspension
- Ampicilin/Sulbactam 3g (Ampicillin 2g/Sulbactam 1g)/vial injectable suspension
- Unasyn 1.5g/vial injectable suspension
- Unasyn 3g/vial injectable suspension

Notes

- Frequently used in extra-label fashion, ideal as a perioperative IV antimicrobial as it is broad-spectrum, water-soluble, and bactericidal.

CEFTIOFUR [FARM ANIMAL]

Restriction Status

N/A

Dose

Ceftiofur HCl (Excenel®, Spectramast®)

Species	Usage	Dose
Camelids	**For metritis, interdigital necrobacillosis (foot rot), pododermatitis and neonatal sepsis**	1.1-2.2mg/kg IM or SQ q12-24h (extra-label)
	Label dose	1.1-2.2mg/kg IM or SQ for 3-5d (4-5d for respiratory disease, 5d for acute metritis); do not give more than 15mL per injection site
Cattle	**For subclinical staphylococcal or streptococcal mastitis**	Infuse one syringe of Spectramast® into affected quarter at dry off
	For clinical mastitis in lactating dairy cattle	Infuse one syringe of Spectramast® into the affected quarter, repeat q24h for up to 8d
Small Ruminants	**N/A**	N/A
Swine	**Label dose**	3-5 mg/kg IM q24h for 3d

Ceftiofur crystalline free acid (Excede®)

Species	Usage	Dose
Camelids	**For metritis, interdigital necrobacillosis (foot rot), pododermatitis and neonatal sepsis**	6.6mg/kg SQ once (extra-label)
Cattle	**For acute metritis ONLY**	6.6mg/kg SQ once in the base of the ear, repeat in 72h
Small Ruminants	**N/A**	N/A
Swine	**For respiratory disease**	5.0mg/kg IM once in the post-auricular region; do not give more than 2mL per injection site

Ceftiofur sodium (Naxcel®, Ceftiflex®)

Species	Usage	Dose
Camelids	**For metritis, interdigital necrobacillosis (foot rot), pododermatitis and neonatal sepsis**	1.1-2.2mg/kg IM, or SQ q24 for 3-5d (extra-label)
Cattle	**Label dose**	1.1-2.2mg/kg IM or SQ q24h for 3-5d
Small Ruminants	**For metritis, respiratory disease, interdigital necrobacillosis (foot rot), pododermatitis and neonatal sepsis**	1.1-2.2mg/kg IM q24h for 3d
Swine	**Label dose**	3-5mg/kg IM q24h for 3d

Brand Name(s)

Excenel®, Spectramast®, Excede®, Naxcel®, Ceftiflex®

Background

Ceftiofur is a bactericidal, time-dependent third generation cephalosporin (β-lactam) antibiotic with a broad spectrum of efficacy against Gram-positive bacteria, Gram-negative bacteria including *Enterobacteriaceae*, and anaerobes including *Clostridium* spp. and *Fusobacterium* spp. Distribution throughout the body is wide, including penetration into joints and synovial fluid. Excretion is primarily in the urine.

Current Uses within OSU-VMC

- Treatment of bovine or small ruminant respiratory disease associated with *Mannheimia* spp., *Pasteurella* spp., *Histophilus* spp., or other susceptible organisms.
- Treatment of swine respiratory disease associated with *Actinobacillus* spp., *Pasteurella* spp., *Haemophilus* spp., *Streptococcus suis*, or *Salmonella cholerasuis*.
- Treatment of acute post-partum (0-14d) bacterial metritis in cattle, small ruminants, or camelids.
- Treatment of interdigital necrobacillosis (foot rot) or pododermatitis.
- Treatment of subclinical mastitis at time of dry off or clinical mastitis in lactating dairy cattle, typically caused by *Staphylococcus* spp., *Streptococcus* spp., or *Escherichia coli*.
- Treatment of neonatal sepsis.

Contraindicated Uses

- Ceftiofur is permitted for use for indications not specified on the label but must not be used at any dose, frequency/duration, or route of administration other than as specified on the label.

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Excenel 50mg/ml injectable suspension
- Spectramast DC 500mg/10ml intra-mammary suspension
- Spectramast LC 125mg/10ml intra-mammary suspension
- Excede 200mg/ml injectable suspension
- Excede Swine 100mg/ml injectable suspension
- Naxcel 1g/vial (20ml) injectable suspension
- Naxcel 4g/vial (80ml) injectable suspension

Notes

- **IV injection of ceftiofur crystalline free acid may result in death**.
- There are 2 Spectramast® products (LC and DC): LC is a lactating cow formulation and DC is for cows at dry off.

ENROFLOXACIN [FARM ANIMAL]

Restriction Status

Unrestricted in non-food animals; ELDU prohibited in food animal species

Dose

Species	Usage	Dose
Camelids	**Label Dose**	5mg/kg IM, or SQ q12-24h (extra-label use)
Cattle	**Label dose**	• 5-5mg/kg SQ q24h for 3-5d • 5-12.5mg/kg SQ once
Small Ruminants	**Label dose**	No labeled dose.
Swine	**Label dose**	7.5 mg/kg SQ once in the post-auricular region; do not give more than 5mL per injection site

Brand Name(s)

Baytril® 100

Background

Enrofloxacin is a concentration-dependent, bactericidal fluoroquinolone antibiotic with activity primarily against Gram-negative aerobes, such as *Enterobacteriaceae* and *Pseudomonas aeruginosa*. Gram-positive coverage is limited, though enrofloxacin is efficacious against many *Staphylococcus* spp. There is no coverage for anaerobic organisms. Distribution is wide, and excretion is primarily in the urine with also a lesser component of biliary excretion.

Current Uses within OSU-VMC

- Treatment of bovine respiratory disease associated with *Mycoplasma bovis*, *Pasteurella haemolytica*, *Pasteurella multocida*, or *Haemophilus somnus*.
- Treatment of swine respiratory disease associated with *Mycoplasma hyopneumoniae*, *Bordetella bronchiseptica*, *Actinobacillus pleuropneumoniae*, *Pasteurella multocida*, *Haemophilus parasuis*, or *Streptococcus suis*.

- Treatment of swine colibacillosis (*Escherichia coli* enteritis) in weaned pigs.

Contraindicated Uses

- Empiric treatment of *Streptococcus* spp. (efficacy is variable; culture and susceptibility testing recommended).
- Anaerobic infections.

Illegal Uses

- **Extra-label drug use is prohibited in food animal species**. Must only be used for therapeutic indication, species, dose, duration/frequency, and route of administration as stated on product label.
- Not approved for use in lactating dairy cattle (>20 months of age) or calves to be processed for veal.

Formulations Available within the OSU Pharmacy

- Enrofloxacin 100mg/ml injectable suspension
- Enrofloxacin 20mg/ml oral suspension
- Enrofloxacin 22.7mg tablet
- Enrofloxacin 68mg tablet
- Enrofloxacin 136mg tablet
- Baytril 22.7mg/ml injectable suspension
- Baytril 100mg/ml injectable suspension
- Baytril 22.7mg tablet
- Baytril 68mg tablet

Notes

- None.

ERYTHROMYCIN [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**Label dose**	No labeled dose.
Cattle	**Label dose (for bovine respiratory disease)**	8.8mg/kg IM q24h for up to 5d; do not give more than 10mL per injection site or 4mL per site in calves
	For pro-motility effects	8.8 mg/kg IV (extra-label use)
Small Ruminants	**Label dose**	No labeled dose.
Swine	**Label dose**	No labeled dose.

Brand Name(s)

Erythrocin Lactobionate, etc.

Background

Erythromycin is a concentration-dependent, primarily bacteriostatic macrolide antibiotic. It may be bactericidal at high concentrations. Erythromycin is active against Gram-positive aerobes. There is also efficacy against non-enteric Gram-negatives such as *Actinobacillus* spp. and *Pasteurella* spp., and anaerobes such as *Clostridium* spp. and *Fusobacterium* spp. Distribution is wide, though it penetration of abscesses, sites of tissue necrosis, and the CNS is poor. Excretion is primarily in bile.

Current Uses within OSU-VMC

- Treatment of bovine respiratory disease associated with susceptible *Pasteurella multocida* isolates.

Contraindicated Uses

- Treatment of abscesses or sites of tissue necrosis.
- Not approved for use in lactating dairy cattle (>20 months of age) or calves to be processed

for veal.

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Erythromycin 500mg/10ml injectable suspension

Notes

- Erythromycin is commonly used as a prokinetic agent to stimulate abomasal emptying and GI motility.
- IM administration is painful and not recommended.

FLORFENICOL [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**For respiratory disease, interdigital necrobacillosis (foot rot), or pododermatitis**	20mg/kg IM or SQ q24h (extra-label use)
Cattle	**Nuflor® Label dose**	20mg/kg IM q48h *or* 40mg/kg SQ once; do not give more than 10mL per injection site
	Nuflor Gold® Label dose	40mg/kg SQ once; do not give more than 15mL per injection site
Small Ruminants	**For respiratory disease, interdigital necrobacillosis (foot rot), or pododermatitis**	20mg/kg IM q24h for 2d (extra-label use)
Swine	**Label dose**	No labeled dose.

Brand Name(s)

NuFlor®, Nuflor Gold®, Resflor Gold®

Background

Florfenicol is a time-dependent, bacteriostatic acetamide antibiotic with a very broad spectrum of activity, including Gram-positive and Gram-negative aerobes, and anaerobes. Florfenicol is widely distributed throughout the body and crosses the blood-brain barrier. Elimination is through hepatic metabolism, and inactive metabolites are excreted in the urine. Florfenicol is a good choice of antibiotics for treatment of intracellular pathogens.

Current Uses within OSU-VMC

- Treatment or control of bovine respiratory disease associated with *Mannheimia* spp., *Pasteurella* spp., and *Histophilus* spp. Some products include additional coverage for *Mycoplasma bovis*.
- Treatment of respiratory disease in small ruminants and camelids.
- Treatment of interdigital necrobacillosis (foot rot) or pododermatitis.

Contraindicated Uses

- Not approved for use in lactating dairy cattle (>20 months of age) or calves to be processed for veal.

Illegal Uses

- Although not illegal, since this product is not approved for use in lactating dairy cattle, a zero drug tolerance is established in any tissues (meat or milk) from dairy cattle > 20 months of age.

Formulations Available within the OSU Pharmacy

- Nuflor 300mg/ml injectable suspension

Notes

- In cattle, give injections only in the neck.

ISONIAZID* [FARM ANIMAL]

Restriction Status

*Isoniazid has a **"selectively use"** status within the OSU-VMC. Therefore, this antibiotic should NOT be used as empirical or first-line treatment. Rather, it should only be used when other agents are inappropriate or ineffective, and culture/sensitivity results indicate that isoniazid is effective against the pathogen.

Dose

Species	Usage	Dose
Camelids	**Label dose**	10 mg/kg PO q24h, a 30d treatment regimen has been recommended in camelids
Cattle	**Label dose**	10 mg/kg PO q24h
Small Ruminants	**Label dose**	10 mg/kg PO q24h
Swine	**Label dose**	No labeled dose.

Brand Name(s)

N/A

Background

Isoniazid is a time-dependent anti-mycobacterial antimicrobial with *in vitro* bactericidal activity against rapidly-dividing mycobacteria in the growing phase, and bacteriostatic activity against slowly-dividing mycobacteria. *In vivo* efficacy is uncertain. Because of the importance of isoniazid as a treatment for human tuberculosis, use of isoniazid is controversial in animals. Pharmacokinetics are poorly understood in animals, but in humans, isoniazid is widely distributed, including into the CNS and caseous material. Elimination is through hepatic metabolism, and inactive metabolites are excreted into the urine.

Current Uses within OSU-VMC

- Treatment of *Actinomyces* sp., *Actinobacillus* sp., or chronic abscesses.

Contraindicated Uses

- Has been suggested for management of Johne's Disease (*Mycobacterium avium* subsp.

paratuberculosis) in animals of particular financial or sentimental value. This is not recommended since it is not a curative treatment.

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Isoniazid 300mg tablet

Notes

- Commonly used to treat lumpy jaw (*Actinomyces bovis)* and wooden tongue (*Actinobacillus lignieresii)*.

OXYTETRACYCLINE [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

(Doses and indications may vary with brand name product. Consult product label.)

Species	Usage	Dose
Camelids	**For susceptible pathogens**	• 10mg/kg IV q12-24h (extra-label use) • 20mg/kg IM or SQ q24-72h (extra-label use)
Cattle	**Oxytetracycline 200mg/mL (e.g. Liquamycin-200®, Bio-Mycin-200®) Label dose for pneumonia**	20mg/kg SQ, IV, or IM once
	Oxytetracycline 200mg/mL (e.g. Liquamycin-200®, Bio-Mycin-200®) Label dose for other indications	6.6-11mg/kg SQ, IV, or IM q24h for up to 4d
	Oxytetracycline 300mg/mL (e.g. Tetradure-300®) Label dose for pneumonia or pink eye	20-30mg/kg IM or SQ once
	Oxytetracycline 300mg/mL (e.g. Tetradure-300®) Label dose for other indications	6.6-11mg/kg IM, SQ, or IV (given slowly) q24h for no more than 4d
	Oxytetracycline 300mg/mL (e.g. Tetradure-300®) for combination products with flunixin (e.g. Hexasol®)	30mg/kg IM or SQ once; do not give more than 10mL per injection site
Small Ruminants	**For susceptible pathogens**	• 10mg/kg IV or IM q12-24h • Long-acting formulas: 20mg/kg IM q48-72h
Swine	**Tetradure-300® Label dose**	• 20mg/kg IM once • 6.6-11mg/kg IM q24h for up to 4d

Brand Name(s)

Bio-Mycin® 200, Liquamycin (LA)-200®, Tetradure-300®, Hexasol, Terramycin® ointment, etc.

Background

Oxytetracycline is a time-dependent, bacteriostatic tetracycline antibiotic with a broad spectrum of activity against many Gram-positive and Gram-negative aerobes. It is **not effective** against *Proteus* spp. or *Pseudomonas* spp. Efficacy against clostridial organisms is variable. Intracellular organisms are highly susceptible. Distribution is widespread, but oxytetracycline does not enter the central nervous system. Oxytetracycline undergoes entero-hepatic recycling and is primarily excreted in the urine.

Current Uses within OSU-VMC

- Treatment of bovine or small ruminant respiratory disease associated with susceptible *Pasteurella* spp., *Mannheimia* spp., *Histophilus* spp., or *Haemophilus* spp., or calf diphtheria.
- Treatment of swine respiratory disease associated with susceptible *Pasteurellaceae* spp.
- Treatment of infectious bovine keratoconjunctivitis (pinkeye) associated with *Moraxella bovis*.
- Treatment of interdigital necrobacillosis (foot rot) or pododermatitis.
- Treatment enteritis (scours) in calves, small ruminants, and swine.
- Treatment of Wooden Tongue (*Actinobacillus lignieresii*).
- Treatment of leptospirosis in cattle and swine.
- Treatment of acute metritis or wound infections associated with *Streptococcus* or *Staphylococcus* spp.
- Treatment of in the face of an abortion outbreak in ewes associated with *Chlamydophila* spp., *Campylobacter* spp., or *Coxiella burnetii*.

Contraindicated Uses

- None

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Oxytetra 100mg/ml injectable suspension
- Oxytetra 200 mg/ml injectable suspension

Notes

- None.

PENICILLIN [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

(**Doses and indications may vary with brand name product. Consult product label.**)

Species	Usage	Dose
Camelids	**Procaine Penicillin G**	22,000 IU/kg SQ q12h *or* 44,000 IU/kg SQ q24h (extra-label use)
Cattle	**Procaine Penicillin G**	12,000 IU/kg IM q24h *or* 20,000 IU/kg IM q24h *or* 40,000 IU/kg IM q24h (extra-label use)
	Penicillin G procaine + penicillin G benzathine combination	12,000 – 40,000 IU/kg + 12,000 – 40,000 IU/kg IM twice, 48h apart
Small Ruminants	**For susceptible pathogens**	12,000 – 40,000 IU/kg IM q24h for no longer than 7d (extra-label use)
Swine	**For susceptible pathogens**	12,000 – 40,000 IU/kg IM q24h for no longer than 7d (extra-label use)

Brand Name(s)

procaine penicillin G, potassium penicillin G

Background

Penicillin G is a bactericidal, time-dependent β-lactam antibiotic with good activity against many Gram-positive aerobes and anaerobes, though it is **not effective** against β-lactamase-producing bacteria. It is also effective against spirochetes. There is limited efficacy against Gram-negative bacteria. Penicillin G distributes widely through the plasma but has low lipid solubility, and does not penetrate abscesses or sites of tissue necrosis well. The active form of penicillin G is excreted in high concentration in the urine.

Current Uses within OSU-VMC

- Treatment of bovine or small ruminant respiratory infections associated with *Pasteurella* spp. or other susceptible organisms.

- Treatment of swine respiratory infections associated with *Pasteurella* spp., *Streptococcus* spp., or other susceptible organisms.
- Treatment of clostridial infections.
- Treatment of swine erysipelas (diamond skin disease).

Contraindicated Uses

- Empirical treatment of suspected staphylococcal infections.
- Empirical treatment of suspected *Enterobacteriaceae* infections.
- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).

Illegal Uses

- None

Formulations Available within the OSU Pharmacy

- Penicillin gel 5ml/syringe
- Penicillin G Potassium 20mmu injectable suspension
- Penicillin G Procaine injectable suspension (1 ml, 30 ml, 100 ml, 250 ml)

Notes

- Intravascular injection of procaine penicillin G can cause excitement, seizure-like activity, and death.
- **Procaine penicillin G is labelled for IM administration only. If given by any other route of administration, the withdrawal time will need to be extended.**
- **Potassium penicillin is given IV.**

SULFADIMETHOXINE [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**For coccidiosis**	55mg/kg PO q24h
Cattle	**Label Dose**	• 55mg/kg PO or IV once followed by 27.5mg/kg q24h PO or IV for up to 5d • Also available in boluses. See product label.
Small Ruminants	**Label Dose**	No labeled dose.
Swine	**Label Dose**	No labeled dose.

Brand Name(s)

Albon®, Agribon ®

Background

Sulfadimethoxine is a time-dependent, bacteriostatic sulfonamide antibiotic with activity primarily against Gram-positive and Gram-negative aerobes (though resistance is widespread among *Enterobacteriaceae* spp.), and to some lesser extent Gram-positive and Gram-negative anaerobes. It is also efficacious against *Coccidia* spp. Distribution throughout the body is wide, including across the blood-brain barrier and into respiratory secretions, and elimination is primarily in the urine as both active drug and metabolites.

Current Uses within OSU-VMC

- Treatment of bovine respiratory disease associated with *Pasteurella* spp., or calf diphtheria.
- Treatment of interdigital necrobacillosis (foot rot) or pododermatitis.
- Treatment of coccidiosis in camelids (only acceptable use in this species).

Contraindicated Uses

- Inactivated in the presence of purulent or necrotic material (e.g. abscesses).

Illegal Uses

- Not approved for use in female dairy cattle >20mos

Formulations Available within the OSU Pharmacy

- Albon 250 mg tablet
- Albon 50 mg/ml oral suspension

Notes

- Polioencephalomalacia (cerebrocortical necrosis) is a potential an adverse effect in ruminants and camelids.

TULATHROMYCIN [FARM ANIMAL]

Restriction Status

Unrestricted

Dose

Species	Usage	Dose
Camelids	**Label Dose**	No labeled dose.
Cattle	**Label Dose**	2.5mg/kg SQ once
Small Ruminants	**For goats**	2.5mg/kg SQ once, repeat in 7d if necessary (extra-label use)
Swine	**Label Dose**	2.5mg/kg IM once

Brand Name(s)

Draxxin®

Background

Tulathromycin is a concentration-dependent, bacteriostatic, macrolide antibiotic. Tulathromycin is active against Gram-negative aerobes and has improved efficacy against Gram-negative aerobes compared to other macrolide antibiotics. Tulathromycin is also efficacious against *Mycoplasma* spp. and anaerobes such as *Fusobacterium* spp. Distribution is wide throughout the body, and tulathromycin has a tendency to accumulate and persist in the lungs. Excretion is primarily as unchanged drug in feces and urine.

Current Uses within OSU-VMC

- Treatment or control of bovine respiratory disease associated with *Mannheimia* spp., *Pasteurella* spp., *Histophilus* spp., or *Mycoplasma* spp.
- Treatment or control of swine respiratory disease associated with *Actinobacillus* spp., *Pasteurella* spp., *Bordetella bronchiseptica*, *Haemophilus* spp., or *Mycoplasma* spp.
- Treatment of bovine interdigital necrobacillosis (foot rot).
- Treatment of infectious bovine keratoconjunctivitis (pinkeye).

Contraindicated Uses

- Not approved for use in lactating dairy cattle (>20 months of age)

Illegal Uses

- Although not illegal, since this product is not approved for use in lactating dairy cattle, a zero drug tolerance is established in any tissues (meat or milk) from dairy cattle > 20 months of age.

Formulations Available within the OSU Pharmacy

- Draxxin 100mg/ml injectable suspension

Notes

- Do not inject more than 10mL per site in cattle, or 2.5mL per site in swine.

ADDITIONAL RESOURCES

ACVIM/ISACID Consensus Statements

Companion Animals

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