# Guide For Antimicrobial Use In Dogs and Cats

The information provided sets out prescribing guidelines to aid veterinarians in the use of antimicrobials for dogs and cats. Designed as a portable A5 flipbook.

## Page 1 (front cover):

Guide For Antimicrobial Use In Dogs and Cats

University of Melbourne

For more information and further resources visit the Australian Veterinary Prescribing Guidelines of the University of Melbourne website at www.fvas.unimelb.edu.au/vetantibiotics

Developed and designed by Agriculture Victoria, the University of Melbourne, the Asia-Pacific Centre for Animal Health and the National Centre for Antimicrobial Stewardship.

## Page 2 (inside front cover):

 Figure Not all bugs need drugs grey and green logo

Play your part in preventing antibiotic resistant infections.

For more information visit the Antimicrobial resistant infections page of the Agriculture Victoria website at agriculture.vic.gov.au/amr

We all have an important role to play in the fight against antimicrobial resistance.

As part of our commitment to the implementation of the National Antimicrobial Resistance Strategy 2015-2019, AgVic and The University of Melbourne have created education materials about antimicrobial resistance (AMR) and antimicrobial stewardship (AMS). The resources aim to provide a practical guide for the prescribing of antimicrobials that can help start the conversation about AMR with clients.

FREE RESOURCES

• A5 antibiotic category cards for cattle, horses, sheep, chickens and pigs

• Pocket guide for antimicrobial use in horses • A3 waiting room posters

• A5 prescribing tearaway pads • A4 fact sheet on MRSP • A6 sticker sheets

• DL Double-sided prescribing leaﬂets • A4 S4 medicated feed order posters

• A2 Australian Prescribing Guidelines for horses • Antibiotic Guardian lapel pins

You can order our resources by emailing animal.biosecurity@agriculture.vic.gov.au

## Page 3:

### Antibiotic Pharmacokinetics & Pharmacodynamics

Bacteriostatic Vs Bactericidal

Bacteriostatic

* “ECSTaTiC for bacteriostatic”
* Erythromycin (macrolides)
* Clindamycin
* Sulphonamides
* Trimethoprim
* Tetracyclines
* Chloramphenicol

Bactericidal

* “Very Proficient For Complete Cell Murder”
* Vancomycin
* Penicillin
* Fluoroquinolones
* Cephalosporins
* Carbapenems
* Metronidazole

Intrinsic resistance Vs Acquired resistance

Intrinsic resistance

* All members of a bacterial genus or species have properties that make them naturally resistant to certain antimicrobials.

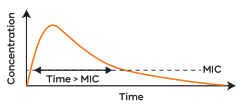
Acquired resistance

* Previously susceptible bacteria acquire new genes or a mutation occurs conferring resistance.

Time-Dependent Vs Concentration Dependent

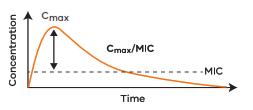
Time-Dependent

* Optimise killing by maximising time above MIC.
* More frequent administration or extended infusion increases efficacy by extending T>MIC.
* Goal exceed MIC by 1-5 times for 50-80% of dosage interval.
* E.g. penicillin, cephalexin, TMS, tetracyclines, clindamycin.

 Figure Concentration vs time curve showing MIC

Concentration Dependent

* Optimise killing by maximising peak concentration.
* Higher doses at less frequent intervals (ie. once daily) increases efficacy by maximising Cmax:MIC ratio.
* Goal Cmax:MIC >8.
* E.g. aminoglycosides, fluoroquinolones, metronidazole.

 Figure Concentration vs time curve showing Cmax/MIC

## Page 4:

Table showing Spectrum of Activity Against Common Bacteria

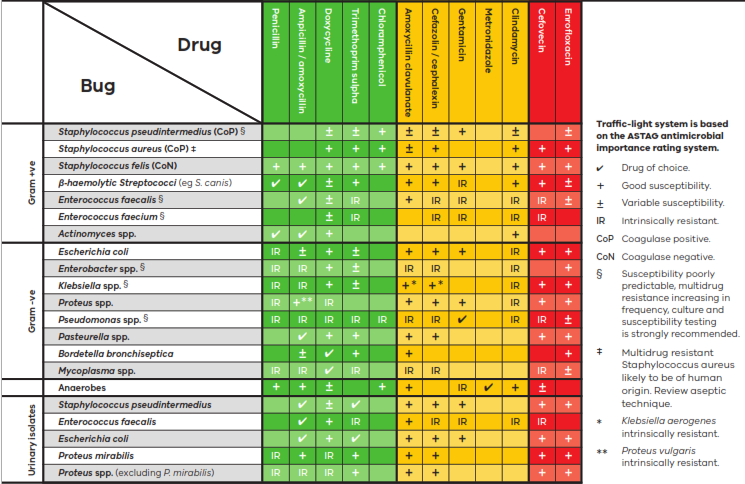


Figure 4 A guide to empirical therapy while awaiting susceptibility results

## Pages 5 to 12:

Tabulated brief descriptions of common antibiotics by drug class, importance rating, antibiotic, route, drug dose, adverse reactions and clinical pearls.

### Drug Class: Beta-lactams

|  |  |
| --- | --- |
| Antibiotic | Amoxycillin |
| Importance Rating | Low |
| Route | IV, IM, PO |
| Drug Dose | 11-22mg/kg q8-12h |
| Adverse Reactions | Anaphylaxis rare, other mild hypersensitivity reactions more common (urticaria, fever, angioneurotic oedema). Anorexia, vomiting, diarrhoea. |
| Clinical Pearls | Anaerobic activity useful for cat-bite infections, periodontal disease, tooth abscesses, wound infections. Drug of choice for streptococci, clostridia, actinomycosis and Pasteurella multocida. Greater activity against Gram negative bacteria than penicillin, including E. coli and Proteus mirabilis. Very high urinary concentrations, useful for UTIs, even penicillinase-producing S. aureus. Not recommended for pyelonephritis or prostatitis. Excreted in bile, therefore good for cholestatic infections. |
| Antibiotic | Ampicillin |
| Importance Rating | Low |
| Route | IV, IM, SC |
| Drug Dose | 10-20mg/kg q6-8h |
| Adverse Reactions | Hypersensitivity reactions and gastrointestinal disturbance  possible. |
| Clinical Pearls | Slow IV (over 3 mins). Spectrum of activity equivalent to amoxycillin. |
| Antibiotic | Penicillin |
| Importance Rating | Low |
| Route | IM |
| Drug Dose | 20- 40,000 IU/kg q12h |
| Adverse Reactions | Hypersensitivity reactions. |
| Clinical Pearls | Indicated for Gram-positive aerobic and anaerobic bacteria (streptococci, clostridia) and for infections caused by susceptible Gram-negative bacteria e.g. P. multocida. |
| Antibiotic | Amoxycillin clavulanic acid |
| Importance Rating | Medium |
| Route | PO, IM, SC, IV |
| Drug Dose | 12.5-25mg/kg q8-12h |
| Adverse Reactions | Pain on injection. Anorexia, vomiting, diarrhoea. Hypersensitivity reactions. Anaphylaxis after intravenous administration during general  anaesthesia. |
| Clinical Pearls | Clavulanic acid extends the range of amoxycillin against β-lacatamase  producing pathogens, such as methicillin-susceptible staphylococci.  Higher dose recommended for Gram-negative infections. |
| Antibiotic | Cefazolin |
| Importance Rating | Medium |
| Route | IV, IM |
| Drug Dose | 20-35mg/kg q8h for therapy,  22 mg/kg surgical prophylaxis |
| Adverse Reactions | Hypersensitivity reactions, pain on IM injection. |
| Clinical Pearls | 1st generation cephalosporin active against methicillin-susceptible  staphylococci, streptococci, some Gram-negative aerobes, unpredictable against anaerobes. Greater Gram-negative activity than cephalexin and cephalothin. Good bone penetration.  For surgical prophylaxis administer IV 30-60 mins before first incision. Repeat intra-operative dosing interval q4hrs for common skin flora (staphylococci, streptococci), q2hrs for E. coli. |
| Antibiotic | Cephalexin |
| Importance Rating | Medium |
| Route | PO |
| Drug Dose | 22-30mg/kg q12h |
| Adverse Reactions | Vomiting and diarrhoea common when administered without food.  Hypersensitivity reactions possible. |
| Clinical Pearls | 1st generation cephalosporin, similar activity to cefazolin except less Gram-negative activity. Give with food to reduce GIT side effects, can also lower dose if side effects occur. Only use for skin disease when topical therapy insufficient to control pyoderma. |
| Antibiotic | Cefovecin |
| Importance Rating | High |
| Route | SC |
| Drug Dose | 8mg/kg |
| Adverse Reactions | Vomiting, diarrhoea, hypersensitivity. |
| Clinical Pearls | 3rd generation cephalosporin. Similar spectrum of activity to amoxycillin clavulanate. Reserve\*\* for infections where no effective alternative. Label restraint FOR USE ONLY in dogs and cats where indicated by antibiotic sensitivity testing according to principles of prudent use. |
| Antibiotic | Ceftazidime |
| Importance Rating | High  High importance rated antibiotics not registered for use in animals that should be avoided or ONLY used in exceptional circumstances  \*\* Exceptional circumstances defined as use in an animal based on culture and susceptibility, where there is no effective alternative therapy and a reasonable chance of survival. |
| Route | IV |
| Drug Dose | 25-50mg/kg q8-12h To exceed P. aeruginosa MIC 30mg/kg q4h or constant IV infusion of 4.1mg/kg/h |
| Adverse Reactions | Gastrointestinal disturbance. |
| Clinical Pearls | 3rd generation cephalosporin with 10 times greater activity against  P. aeruginosa. Slightly less active against all other organisms than other cephalosporin. Reserve\*\* for P. aeruginosa Infections with confirmed  susceptibility. |
| Antibiotic | Cefotaxime |
| Importance Rating | High  High importance rated antibiotics not registered for use in animals that should be avoided or ONLY used in exceptional circumstances  \*\* Exceptional circumstances defined as use in an animal based on culture and susceptibility, where there is no effective alternative therapy and a reasonable chance of survival. |
| Route | IM |
| Drug Dose | 20- 40 mg/kg q8h |
| Adverse Reactions | Pain on IM injection, gastrointestinal disturbances common due to broad antibacterial action. Superinfection with resistant  microorganisms, including yeasts, may be anticipated. |
| Clinical Pearls | 3rd generation cephalosporin.  Due to expense and potential to select for resistant infections, these drugs should be reserved\*\* for life-threatening infections, such as bacterial meningitis caused by Gram-negative bacteria (especially Enterobacteriaceae). May be used in combination with an  Aminoglycoside for MDR infections in compromised animals (neutropaenic). |

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| --- | --- |
| Antibiotic | Doxycycline |
| Importance Rating | Low |
| Route | PO |
| Drug Dose | 5mg/kg q12h or 10mg/kg q24h |
| Adverse Reactions | Administration to growing puppies and pregnant bitches results in yellow discolouration of teeth. |
| Clinical Pearls | Excellent penetration into most tissues (including prostate). Broad spectrum activity, including many intracellular pathogens such as Chlamydia, Coxiella, Nocardia and some Mycoplasma species. |

### Drug Class: Tetracyclines

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| --- | --- |
| Antibiotic | Trimethoprim sulphonamide |
| Importance Rating | Low |
| Route | PO, IV |
| Drug Dose | 15- 30 mg/kg q12h |
| Adverse Reactions | Chronic use (>2 weeks) can lead to crystalluria, haematuria, urinary obstruction, haematopoietic disorders, anaemia, leukopaenia, thrombocytopaenia) and dermatological reactions. Do not use in Doberman Pinschers. ~0.25% of dogs may suffer idiosyncratic drug reactions 10-21 days after exposure, including fever, arthropathy, blood dyscrasia, epistaxis, hepatopathy, skin eruptions, uveitis, KCS. In dogs <12kg, 1-week TMS decreases tear production by 15%, overdose can lead to KCS. Can cause hypothyroidism and/or lowered T4 in dogs. Cats salivate if tablet protective coating broken. |
| Clinical Pearls | Broad spectrum activity, including Nocardia spp., Toxoplasma spp. And other protozoa. Well absorbed from gastrointestinal tract, excellent penetration into many tissues including meninges, prostate and urinary tract. ISCAID recommended first line empirical treatment option for sporadic bacterial cystitis (simple uncomplicated UTI) for 3-5 days (low risk of adverse effects with short course). For therapy >7 days baseline Schirmer’s tear testing recommended with periodic re-evaluation. |

|  |  |
| --- | --- |
| Antibiotic | Gentamicin |
| Importance Rating | Medium |
| Route | IV, IM |
| Drug Dose | Dogs:9-14 mg/kg q24h  Cats:5-8 mg/kg q24h |
| Adverse Reactions | Ototoxicity possible. Nephrotoxic especially if hypovolaemia, hypokalaemia, hyponatraemia, elevated trough concentrations, pre-existing renal disease, concurrent nephrotoxic drug administration, prolonged therapy (>7-10 days), age (neonates, geriatrics). Pain on IM injection. |
| Clinical Pearls | Excellent activity against Gram- negative bacteria and some staphylococci. No anaerobic activity. Synergistic in combination with β-lactam. Inactivated by purulent debris. Ensure adequate fluid and electrolyte balance during treatment. Clinical monitoring for toxicosis may include monitoring trough levels, daily monitoring of urine for epithelial casts and daily serum creatinine. |

### Drug Class: Sulphonamides

### Drug Class: Aminoglycosides

### Drug Class: Nitroimidazoles

|  |  |
| --- | --- |
|  | |
| Antibiotic | Metronidazole |
| Importance Rating | Medium |
| Route | PO,IV |
| Drug Dose | Dogs: 10-15mg/kg PO q12h (10mg/kg SLOW IV)  Cats: 10-15mg/kg q24h |
| Adverse Reactions | Care in liver disease, can predispose to CNS toxicity - reduce dose to 7.5mg/kg. Gastrointestinal disturbance, hepatotoxicity, CNS signs, haematuria, neutropenia. Potentially teratogenic in first third of pregnancy.  Can impact faecal microbiome long-term. |
| Clinical Pearls | Not indicated in acute gastrointestinal disease unless evidence of sepsis. Excellent anaerobic activity. Critical drug for managing human Clostridium difficile infections. Drug interactions: phenobarbital may enhance metabolism; cimetidine may decrease metabolism and increase dose related adverse effects. |

### Drug Class: Nitrofurans

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|  | |
| Antibiotic | Nitrofurantoin |
| Importance Rating | High  High importance rated antibiotics not registered for use in animals that should be avoided or ONLY used in exceptional circumstances  \*\* Exceptional circumstances defined as use in an animal based on culture and susceptibility, where there is no effective alternative therapy and a reasonable chance of survival. |
| Route | PO |
| Drug Dose | 4.4-5 mg/kg q8h |
| Adverse Reactions | Gastrointestinal disturbances, hepatopathy, male infertility in dogs. |
| Clinical Pearls | Lower urinary tract infections only. Reserve\*\* for exceptional cases. Do not use for pyelonephritis or other conditions where tissue (vs. urine) levels are needed. Avoid in cases with renal impairment. No activity against Pseudomonas, Proteus, Serratia, Acinetobacter spp. Probenecid inhibits renal excretion. Antagonistic to fluoroquinolones. |

### Drug Class: Lincosamides

|  |  |
| --- | --- |
| Antibiotic | Clindamycin |
| Importance Rating | Medium |
| Route | IV,IM |
| Drug Dose | 11mg/kg q12h For IV: dilute 1:10 in 0.9% saline, Administer over 60mins 11mg/kg q12-24h  Toxoplasmosis: 25mg/kg q12h |
| Adverse Reactions | Oesophagitis and oesophageal stricture have been reported in cats associated with use of generic capsules - follow capsules with water or food. Diarrhoea, neuromuscular blockade. Oral suspension may be unpalatable for cats. Pain on IM injection. |
| Clinical Pearls | Active against staphylococci, streptococci, Actinomyces, Nocardia, and Mycoplasma spp. plus anaerobes (Bacteroides spp., Fusobacterium spp., Clostridium perfringens). Only use for skin disease when topical therapy insufficient to control pyoderma. Cross-resistance to lincosamides in bacteria resistant to macrolides. High concentration in prostate. Use for toxoplasmosis controversial as may help clinical signs but not clear infection from CNS or eye. Erythromycin and chloramphenicol  are antagonistic. |

### Drug Class: Phenicols

|  |  |
| --- | --- |
| Antibiotic | Chloramphenicol |
| Importance Rating | Low |
| Route | PO, IV, IM, Topical |
| Drug Dose | Dogs: 40-50mg/kg q6-8h  Cats: 12.5-20mg/kg q12h |
| Adverse Reactions | Anorexia, hypersalivation, vomiting with systemic use. Dose related reversible bone marrow suppression may develop with prolonged treatment – usually resolves within days. Cats more susceptible – within 2 weeks of treatment. Wear gloves and mask when handling medication as idiosyncratic aplastic anaemia can develop in people handling this drug. |
| Clinical Pearls | Mostly used topically. May be used systemically for multidrug resistant organisms. Broad spectrum. Avoid systemic use in cases with hepatic failure, renal failure, pre-existing haematologic abnormalities, pregnancy, lactation and in young animals. Eliminated by glucuronidation mechanisms,  cats excrete higher proportion unchanged in urine than dogs. Potent inhibitor of P450 enzymes reduced hepatic Clearance of phenobarbital, pentobarbital. |

### Drug Class: Polypeptides

|  |  |
| --- | --- |
| Antibiotic | Polymixin B |
| Importance Rating | High |
| Route | Topical |
| Drug Dose |  |
| Adverse Reactions | Nephrotoxic if administered systemically. Potentially ototoxic. Ophthalmic formulations associated with anaphylaxis in cats. |
| Clinical Pearls | Used topically for treatment of bacterial keratitis, otitis externa and skin infections. Active topically against Pseudomonas spp. and other Gram negatives (except Proteus, Morganella and Serratia spp.). Inhibited by the presence of purulent exudate. |

### Drug Class: Fluoroquinolones

|  |  |
| --- | --- |
| Antibiotic | Enrofloxacin |
| Importance Rating | High |
| Route | PO,IV |
| Drug Dose | Dogs: 5-20mg/kg q24h  Cats: 5mg/kg q24h, SLOW IV |
| Adverse Reactions | Blindness, due to retinal detachment, and neurological signs in cats. Not always associated with dose or route of administration, however greater risk with advancing age. Anorexia, vomiting, diarrhoea. CNS effects with high doses or rapid IV. Caution in animals prone to seizures. Canine toxic shock syndrome and necrotizing fasciitis caused by fluoroquinolone use in Streptococcus canis infections. Arthropathy in dogs during growth, small dogs <8 months old, or large breeds less than 12-18 months. Avoid use in cats - especially those with renal disease. |
| Clinical Pearls | 2nd generation fluoroquinolone active against Pasteurella spp., Gram- negative enteric bacilli, Staphylococci (higher MIC). Variable activity against Pseudomonas Aeruginosa (highest MIC). Poor activity against streptococci, enterococci and anaerobes. Not indicated in superficial pyoderma. Reserve\*\* for infections where culture and susceptibility indicate no effective alternative. Use is a known risk factor for selection of methicillin-resistant staphylococci. If organism resistant to one fluoroquinolone, typically resistant to all (cross-resistance).  Good distribution to bone, prostate and skin. Concentrated in urine, bile and within phagocytic cells. Enrofloxacin is partially (~20%)  de-ethylated to ciprofloxacin. Oral absorption inhibited by antacids, sucralfate, supplements containing aluminium, calcium, iron and zinc. Chelation/precipitation in IV fluids with calcium or magnesium. Reduced hepatic clearance of theophylline. Antagonism with chloramphenicol,  rifampicin. |
| Antibiotic | Marbofloxacin |
| Importance Rating | High |
| Route | PO |
| Drug Dose | 2.75-5.5mg/kg q24h |
| Adverse Reactions | Anorexia, vomiting, diarrhoea. CNS effects with high doses or rapid IV. Caution in animals prone to seizures. Arthropathy in immature animals. |
| Clinical Pearls | 2nd generation fluoroquinolone. Reserve\*\* for infections where culture and susceptibility indicate no effective alternative. Similar activity, tissue distribution, drug interactions to enrofloxacin. Concentrated in urine, may be used for confirmed pyelonephritis in cats based on susceptibility testing. |
| Antibiotic | Pradofloxacin |
| Importance Rating | High |
| Route | PO |
| Drug Dose | Dogs: 3-5mg/kg q24h  Cats: 5-10mg/kg q24h |
| Adverse Reactions | Higher doses in dogs associated with myelosuppression. Do not use in dogs less than 1 year of age, or in pregnant or lactating animals. Gastrointestinal disturbances. Caution in animals prone to seizures. |
| Clinical Pearls | 3rd generation fluoroquinolone. Reserve\*\* for infections where culture and susceptibility indicate no effective alternative. Greater activity against Gram-positive cocci and anaerobes than other fluoroquinolones.  Similar drug interactions to enrofloxacin. |
| Antibiotic | Ciprofloxacin |
| Importance Rating | High  High importance rated antibiotics not registered for use in animals that should be avoided or ONLY used in exceptional circumstances  \*\* Exceptional circumstances defined as use in an animal based on culture and susceptibility, where there is no effective alternative therapy and a reasonable chance of survival. |
| Route | PO |
| Drug Dose | 25mg/kg |
| Adverse Reactions |  |
| Clinical Pearls | Avoid. Oral absorption in dogs highly variable (~50%), lower than humans. Only reaches therapeutic targets for bacteria with MIC ≤0.06µg/ml  (vs ≤1µg/ml in humans). Generally not effective for staphylococci or P. aeruginosa in dogs and cats. |

NB. Many recommendations in this guide represent off-label use of antimicrobials. Compliance with legal requirements in your jurisdiction is your responsibility. Recommendations only apply to dogs and cats and cannot be safely extrapolated to other small animal species.

## Page 13:

IMAGE of MRSP dermatology fact sheet

## Page 14(back cover):

 Figure Grey and green Not all Bugs need Drugs logo

Play your part in preventing antibiotic resistant infections.

For more information visit the Antimicrobial resistant infections page of the Agriculture Victoria website at agriculture.vic.gov.au/amr