

## Diagnostic update

# Microbiology guide to interpreting antimicrobial susceptibility testing (AST)

Recent enhancements to the IDEXX antimicrobial susceptibility testing (AST) platform allow for greater adaptability as our understanding of antimicrobial susceptibility changes over time. These enhancements will provide for testing of dose-dependent antimicrobials, expanded species-specific breakpoints, and the inclusion of a wider range of antimicrobial options. IDEXX is committed to supporting antimicrobial stewardship by aligning our practices with the most current clinical standards. IDEXX microbiology laboratories follow the guidelines of the Clinical and Laboratory Standards Institute (CLSI), a global leader in setting quality standards in both human and veterinary medical laboratory testing.

Your IDEXX microbiology results will show the identity of pathogenic organisms and the appropriate antimicrobial susceptibility pattern against each organism. Most antibiograms will include minimum inhibitory concentrations (MICs) in order to help determine the most effective antimicrobial that will result in clinical resolution.

### This guide provides a detailed explanation of the following concepts important in applying an MIC to your specific patient:

- + The MIC number is the lowest concentration (in µg/mL) of an antimicrobial that inhibits the growth of a given strain of bacteria.
- + An MIC number for one antimicrobial CANNOT be compared to the MIC number for another antimicrobial.
- + The choice of antimicrobial should be based on the MIC interpretation, the site of infection, and other criteria. Consider safety, ease of use, and cost when determining the optimum antimicrobial.

### How is the MIC reported?

Next to each antimicrobial is the susceptibility interpretation: S (susceptible), I (intermediate), or R (resistant), and in many cases, followed by the MIC in µg/mL. The MIC breakpoints differ by drug and bacterial species (see table 3), and for this reason, the MIC number cannot be directly compared between drugs. Results may be reported as susceptible to one antimicrobial even if another antimicrobial with the same MIC is listed as intermediate or resistant.

- + If the organism is reported as **susceptible (S, S\*)**, it implies that the infection due to the strain may be appropriately treated with the dosage of antimicrobial recommended for that type of infection.
- + **Intermediate (I)** indicates that the MIC is only approaching attainable blood and tissue concentrations and response rates may be lower than for susceptible strains. There is a likelihood of therapeutic success if exposure to the antimicrobial is increased by adjusting the dosing regimen or by its concentration at the site of infection. Not all organisms/bacteria combinations have an established intermediate interpretation.
- + A result of **resistant (R, R\*)** indicates that the organisms are resistant to the usually attainable concentrations of the antimicrobial.
- + A **susceptible, dose dependent (SDD)** result indicates the susceptibility of an organism depends on the antimicrobial dose being used. The recommended dosages can be found

in the interpretive key at the bottom of your results. Higher doses may be required to be clinically effective. This category is new, and it applies only to canine specimens with certain combinations of bacteria and antimicrobials.<sup>2</sup>

**Table 1:** Example of an antimicrobial susceptibility report

	Isolate 1	MIC
Penicillin	R	≥ 0.25
Amoxicillin-Clavulanic Acid	S	≤ 0.25
Cefovecin	S	≤ 0.5
Enrofloxacin	SDD	≤ 0.12
Marbofloxacin	S	≤ 0.12
Clindamycin	I	1
Amoxicillin	R*	
Cephalexin	S*	
Cefpodoxime	S*	

### When are MICs not performed?

#### MICs are not performed when:

- + The growth requirements of some organisms require the susceptibility testing to be performed by another method.
- + Interpretive criteria is not available from CLSI.
- + Certain antimicrobials are not available on our antimicrobial susceptibility platform.

- + The drug is known to be clinically ineffective against the organism, regardless of the *in vitro* results.
- + The antimicrobial was not directly measured, and the result for the interpretative category was achieved by deduction according to CLSI guidelines.

## Class-reference antimicrobial

Some antimicrobials are used to determine the susceptibility of other antimicrobials in the same class. For example, the presence of methicillin-resistant staphylococci (MRS) is tested in the laboratory with oxacillin and not methicillin. The name MRS is used because of convention over years of use in scientific articles and textbooks. On culture results, S\* or R\* indicates susceptibility has been inferred.

**Table 2:** Class-reference antimicrobial

Antimicrobial	Further application
Amoxicillin	Predicts susceptibility of ampicillin.
Amoxicillin-clavulanic acid	Predicts susceptibility of Clavamox®.
Cephalexin	Predicts susceptibility of all first-generation cephalosporins, except cefazolin.
Clindamycin	Predicts susceptibility of lincomycin. Should not be used in horses, rabbits, and other herbivores. Not effective against aerobic gram-negative bacteria.
Erythromycin	Predicts susceptibility of azithromycin and clarithromycin. Not effective against aerobic gram-negative bacteria.
Oxacillin	Predicts susceptibility to methicillin.
Trimethoprim-sulfa	Predicts susceptibility of other potentiated sulfonamides.

## Antimicrobial selection

When selecting an antimicrobial, keep in mind that other factors in addition to the MIC interpretation are important.

- + The site of infection (achievable drug levels at site of infection).
- + Lipid-soluble drugs (e.g., tetracyclines, macrolides, fluoroquinolones) reach higher levels in the tissue than they do in serum.
- + Drugs excreted by the kidney (e.g., beta-lactams, trimethoprim-sulfas) reach much higher urine levels than serum levels.
- + Topical antimicrobial medications deliver significantly higher concentrations than achieved in serum and may still be effective even if reported as resistant on culture results.
- + Age of the patient, animal species, health of the animal (known organ disorders, immune status).

- + Mode of action (bacteriostatic/bactericidal), spectrum (broad-spectrum versus narrow-spectrum), efficacy against gram-negative versus gram-positive bacteria.
- + Safety/contraindications, possible side effects of the drug, toxicity margin.
- + Ease of use, frequency and route of administration, cost.
- + In patients already on antimicrobials when culture results return, consider de-escalation, using an antimicrobial that targets the known pathogen(s) rather than a broad-spectrum approach, whenever possible.

## Why do some results not include a susceptibility report?

At IDEXX, our microbiology practices are grounded in internationally recognized standards set by CLSI, informed by recommendations endorsed by the American College of Veterinary Microbiologists (ACVM), and shaped by our internal subject matter experts with decades of experience in antimicrobial susceptibility testing. These foundations ensure our processes are both scientifically rigorous and clinically relevant. The following is a brief outline of our antimicrobial testing policy:

- + Susceptibilities are not performed on normal flora, nonpathogenic microorganisms, and specimens with identification of  $\geq 3$  organisms, suggesting contamination of the specimen. MICs are not performed to avoid misinterpretation and inappropriate therapeutic decisions.<sup>1,2</sup>
- + In the uncommon situation where normal or mixed flora is reported from a sterile site, unusual clinical presentations, nonresponding or recurrent infections, test code 8664 (Special Request Organism ID Add-on) can be added to report the identification of all bacteria grown on culture and perform, when technically possible, antimicrobial susceptibility testing.
- + Pathogens with predictable susceptibility patterns or those lacking CLSI standards may be reported with a recommended list of antimicrobials. Examples include  $\beta$ -hemolytic streptococci and *Campylobacter* species.
- + We do not test inappropriate organism/antimicrobial combinations. For example, *E. coli* has intrinsic resistance mechanisms against penicillin, so the antimicrobial will not be tested against this organism.
- + Slow-growing or anaerobic organisms (e.g., *Corynebacterium* spp., *Actinomyces* spp.) may yield unreliable susceptibility results. In such cases, a curated list of recommended antimicrobials may be provided to guide therapy.

**Table 3:** Examples of current antimicrobial MIC ranges for canine and feline patients

Antimicrobial	Species (when applicable)	Breakpoint (µg/mL)		
		Susceptible	Intermediate	Resistant
Amikacin		≤ 4	8	≥ 16
Amoxicillin* <i>Staphylococcus</i> spp.	Cats	≤ 0.25	0.5	≥ 1
Amoxicillin* <i>Staphylococcus</i> spp.	Dogs	≤ 0.25		≥ 0.5
Amoxicillin (urine) Enterobacterales		≤ 8		≥ 16
Amoxicillin-clavulanic acid (skin, soft tissue, urine)*		≤ 0.25	0.5	≥ 1
Amoxicillin-clavulanic acid (urine) Enterobacterales		≤ 8		≥ 16
Cefovecin Enterobacterales		≤ 2	4	≥ 8
Cefovecin (skin, soft tissue) <i>Pasteurella multocida</i>	Cats	≤ 0.12	0.25	≥ 0.5
Cefovecin <i>Staphylococcus</i>		≤ 0.5	1	≥ 2
Cefpodoxime		≤ 2	4	≥ 8
Ceftazidime Enterobacteriaceae		≤ 4	8	≥ 16
Ceftazidime <i>Pseudomonas</i>		≤ 8	16	≥ 32
Cephalexin		≤ 2		≥ 4
Chloramphenicol		≤ 2	4	≥ 8
Ciprofloxacin		≤ 1	2	≥ 4
Clindamycin		≤ 0.5	1–2	≥ 4
Doxycycline <i>Enterococcus</i>		≤ 4	8	≥ 16
Doxycycline <i>Staphylococcus</i>		≤ 0.12	0.25	≥ 0.5
Enrofloxacin	Cats	≤ 0.5	1–2	≥ 4
Enrofloxacin 5 mg/kg PO Q24 or 2.5 mg/kg PO Q12	Dogs	≤ 0.06		≥ 0.5
Enrofloxacin 10 mg/kg PO Q24	Dogs	≤ 0.12		≥ 0.5
Enrofloxacin 20 mg/kg PO Q24	Dogs	≤ 0.25		≥ 0.5
Erythromycin		≤ 0.5	1–4	≥ 8
Florfenicol		≤ 2	4	≥ 8
Gentamicin gram-negative		≤ 2	4	≥ 8
Gentamicin <i>Staphylococcus</i>		≤ 4	8	≥ 16
Imipenem gram-negative		≤ 1	2	≥ 4
Marbofloxacin	Cats	≤ 1	2	≥ 4
Marbofloxacin 2.75 mg/kg PO Q24	Dogs	≤ 0.12		≥ 0.5
Marbofloxacin 5.5 mg/kg PO Q24	Dogs	≤ 0.25		≥ 0.5
Minocycline (skin, soft tissue)		≤ 0.5	1	≥ 2
Nitrofurantoin (only reported on urine)		≤ 32	64	≥ 128
Trimethoprim-sulfa		≤ 40		≥ 80

\*Amoxicillin and amoxicillin-clavulanic acid may appear susceptible when tested *in vitro*, but they may not achieve effective levels at the site of skin and soft-tissue infections with standard dosing.

## Customer support services

IDEXX supports your practice with our customer support, technical support, and medical consulting services teams. Call **1-888-433-9987** if you have questions.

The information contained herein is intended to provide general guidance only. As with any diagnosis or treatment, you should use clinical discretion with each patient based on a complete evaluation of the patient, including history, physical presentation, and complete laboratory data. With respect to any drug therapy or monitoring program, you should refer to product inserts for a complete description of dosages, indications, interactions, and cautions.

## References

1. Cole SD, Paul NC, Hendrix K, et al. Collaboration with the clinical microbiology laboratory optimizes diagnosis of dog and cat infections: recommendations from the American College of Veterinary Microbiologists. *JAVMA*. 2025;263(S1):S88–S97. doi:10.2460/javma.24.12.0776
2. Diaz-Campos DV, Lubbers BV, Schwarz S, et al. *CLSI VET01S: Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated from Animals*. 7th ed. Clinical and Laboratory Standards Institute; 2024.