

# What veterinarians need to know about ANTIMICROBIAL SUSCEPTIBILITY TESTING

## NON-CULTURE-BASED ANTIMICROBIAL RESISTANCE GENETIC PANELS IN ANIMALS

Antimicrobial susceptibility testing (AST) can be a powerful diagnostic tool to guide treatment selection and help predict outcomes for bacterial infections in animals. One reason AST is often underutilized is the delay between sample submission for culture with AST and the availability of results. This delay might encourage some veterinarians to pursue non-culture-based (NCB) methods; however, caution is advised.

Veterinarians have a unifying goal: heal our patients as efficiently as possible. We seek diagnostic tests that are quick and accurate. This helps to prevent unnecessary pain and diminished quality of life, while improving health outcomes and reducing health care costs. For bacterial infections, early identification of the etiologic agent might lead to greater success in selecting optimal antimicrobials, thereby resulting in a better therapeutic outcome with a lower likelihood of antimicrobial resistance development. However, *quicker* does not always mean *better*, and a gain in timeliness could sacrifice important diagnostic qualities, including test specificity. This is exactly the challenge with NCB testing, including metagenomics, for antimicrobial resistance genes.

### // WHAT ARE “CULTURE-BASED METHODS”? //

Traditionally, we identify the cause of an infection and its antimicrobial resistance profile through bacterial culture and AST. However, culture-based testing requires days or weeks for the bacteria to grow, after which AST helps guide treatment options. In between patient presentation and test results, veterinarians might empirically prescribe antimicrobials based on their likelihood to treat the infection.

### // WHAT ARE “NON-CULTURE-BASED METHODS”? //

What if the rate-limiting step in this process—bacterial growth—were eliminated, and sample testing skipped directly to determining which resistance genes the bacteria harbor, to inform treatment? Relatively low-cost methods to do this now exist, referred to as non-culture-based (NCB) methods. Some NCB technologies include PCR or next generation sequencing methods. Results from NCB methods provide the veterinarian with a report of antimicrobial resistant genes within the sampled material. These technologies can reduce result time from days or weeks to hours, once the diagnostic laboratory receives the sample. While NCB methods are theoretically revolutionary, they do have important limitations to consider.

### // IMPROVING TIMELINESS BUT REDUCING SPECIFICITY //

To eliminate the time associated with bacterial culture, NCB methods rely on sample collection, followed by extraction and purification of all genetic material in a sample. This results in

the collection and mixing of DNA or RNA from all pathogens, commensals, and contaminants within the sample, without differentiation. Results must then be interpreted in this context. First, many NCB technologies provide binary results, meaning that they may indicate the presence of an antimicrobial resistance gene in the sample, but not the specific bacteria that harbor the gene, nor whether the harboring bacteria are causing the infection. With few exceptions, NCB methods cannot link resistance genes to their bacterial host. This becomes especially problematic when the infection that prompted the testing is located in an anatomical site that is naturally colonized with commensals or contaminants (e.g., skin, respiratory tract, and gastrointestinal tract). The second caveat is that, unlike traditional AST, which relies on testing whether the bacteria can survive in the presence of the antimicrobials (a phenotypic method), NCB methods simply test for the presence of a gene (i.e., genotype testing) without confirming whether the gene results in active bacterial resistance.

### // PATIENT HEALTH CONSEQUENCES AND ANTIMICROBIAL RESISTANCE REPERCUSSIONS //

Using NCB methods could lead to poorer, rather than better, health outcomes. Without knowing the true etiologic agents and their expressed resistance patterns, consequences include mis-prescribed antimicrobials leading to delayed healing time, unnecessary pain, and wasted resources. Further, the high sensitivity inherent to NCB methods could lead to the conclusion that the bacteria responsible for the infection are more resistant (or susceptible) than they actually are.

### // BOTTOM LINE //

NCB methods are novel and impressive, and these technologies have the potential to be a significant boon in the future; however, at present, our ability to properly interpret the results is hindered, at best. Although likely to change in the coming years, NCB methods currently might best be reserved for research studies and epidemiologic understanding. They are not quite ready for prime time in veterinary practice.

### // ADDITIONAL RESOURCES //

AVMA Committee on Antimicrobials. What veterinarians need to know about antimicrobial susceptibility testing: General overview. [avma.org/AntimicrobialTools](http://avma.org/AntimicrobialTools)

# Antimicrobial susceptibility testing (AST) TRADITIONAL CULTURE VS. NON-CULTURE-BASED METHODS

