VET09

Understanding Susceptibility Test Data as a Component of Antimicrobial Stewardship in Veterinary Settings

This report provides veterinarians with the information needed to successfully acquire and interpret antimicrobial susceptibility test results. It promotes common understanding between the veterinarian and the veterinary microbiology laboratory by providing example culture and susceptibility reports and animal species–specific guidance on applying breakpoints to interpret susceptibility test results.

A CLSI report for global application.

Understanding Susceptibility Test Data as a Component of Antimicrobial Stewardship in Veterinary Settings

Virginia R. Fajt, DVM, PhD, DACVCP
Claire R. Burbick, DVM, PhD, DACVM
Sara Lawhon, DVM, DACVM
Eden Bermingham, DVM, MS, DACVCP
Robert Bowden, BS
Erin Frey, DVM, MPH, DACVPM
Ronette Gehring, BVSc, DACVCP
K. Fred Gingrich II, DVM
Merran Govendir, PhD, BVSc, FHERDSA, MANZCVSc
Beth N. Harris, MS, PhD

Cory Langston, DVM, PhD
Sakurako Marchand, MT
Ron A. Miller, MS, PhD
Mark G. Papich, DVM, MS
Pierre Rouppert
Stefan Schwarz, DVM
Michael T. Sweeney, MS
Anil J. Thachil, BVSc, MVSc, PhD, DACVM
Jeffrey L. Watts, PhD, RM(NRCM), M(ASCP)

Abstract

Clinical and Laboratory Standards Institute report VET09—*Understanding Susceptibility Test Data as a Component of Antimicrobial Stewardship in Veterinary Settings* discusses antimicrobial susceptibility testing (AST) that provides important, clinically relevant information to the submitting veterinarian if the veterinarian understands how the testing is performed and how the results can be interpreted. This report provides veterinarians background information about laboratory processes, including how AST is performed, reasons for AST not being performed, and how AST results are assessed by the laboratory. It also describes the reasons for varying degrees of confidence in applying breakpoints for interpreting AST results, which will empower veterinarians as they make decisions about the use of antimicrobial agents to treat bacterial disease in animals.

This report gives an overview of some of the factors that affect antimicrobial drug selection in animals, including principles of antimicrobial pharmacology, how bacterial species identification affects AST results interpretation, and the veterinarian's role in ensuring AST results are accurate and useful. By providing example susceptibility test reports with callout boxes, important facets of laboratory reports with AST results are highlighted to aid the veterinarian in maximizing the data.

This report has separate chapters for animal species–specific guidance on how to interpret AST data for dogs, cats, horses, cattle, pigs, and fish, and uniquely, it provides evidence-based appraisals of confidence in the AST data reported by laboratories. This guidance can be also used by laboratories to select appropriate breakpoints for assigning interpretive categories and to aid client veterinarians in interpreting their data.

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Foreword

This report is designed to provide veterinarians and other stakeholders in veterinary diagnostics with key information needed to appropriately interpret antimicrobial susceptibility testing (AST) data for application to clinical decision-making. This report can therefore be read from beginning to end for a comprehensive overview by animal species, bacterial type, and antimicrobial agents in the context of AST. However, each chapter is also designed to provide stand-alone information, so the report can be sampled as needed.

This report includes general guidance on how to apply pharmacological principles to selection and use of antimicrobial agents and how to get the best information from the laboratory, starting with submitting an animal specimen for culture through receiving the laboratory report with AST results. Basic components of a laboratory report and specific examples with AST results are included with commentary on the information reported, as well as different presentations that clinicians may receive from different laboratories. There is also an overview of regulatory and legal considerations for antimicrobial agents. Finally, separate chapters are included that focus on AST results interpretations applied to different animal species: dogs, cats, horses, cattle, pigs, and fish.

Some unique information included in this report is not available anywhere else, including recommendations on extrapolating from:

- One infection site to another
  - For example, whether a breakpoint established for *Escherichia coli* from skin and soft-tissue infections in dogs can be applied to *E. coli* isolated from the lungs
- One bacterial species to another
  - For example, whether a breakpoint established for *E. coli* can be applied to *Klebsiella pneumoniae*
- One animal species to another
  - For example, whether it is reasonable to apply canine breakpoints to bacterial isolates from cats

NOTE: The content of this report is supported by the CLSI consensus process and does not necessarily reflect the views of any single individual or organization.

⚠ **NOTE:**

Each chapter in this report is designed to provide stand-alone information.

KEY WORDS

Antimicrobial stewardship	**Interpretive categories**	**Species-specific breakpoints**
Antimicrobial susceptibility testing	**Laboratory**	**Veterinary**
Breakpoints	**Reporting**	

Chapter ❶

Introduction

This chapter includes:

- Report's scope and applicable exclusions

- Background information pertinent to the report's content

- Standard precautions information

- "Note on Terminology" that highlights particular use and/or variation in use of terms and/or definitions

- Terms and definitions used in the report

- Abbreviations and acronyms used in the report

Understanding Susceptibility Test Data as a Component of Antimicrobial Stewardship in Veterinary Settings

1 Introduction

1.1 Scope

This report is designed to facilitate common understanding among veterinarians, microbiologists, and laboratorians about how antimicrobial susceptibility testing (AST) is performed, and how the results can be interpreted and applied to clinical decision-making. The intended audience includes veterinarians, microbiologists, laboratorians conducting *in vitro* testing, veterinary educators, pharmacists, and students.

> **This report provides information that may be used in concert with other efforts and activities to support antimicrobial stewardship, such as those advocated by professional associations[1] or regulatory agencies.[2]**

To provide this information, the report includes an overview of pharmacological principles relevant to antimicrobial agent selection, some general principles about differences among animal species that may affect antimicrobial agent use and efficacy, and how bacterial species affects AST results and interpretations. This information also helps to explain how microbiological and pharmacological data are used to develop breakpoints. Example AST reports are included, in which common questions are answered and misconceptions are clarified. A large portion of this report provides animal species–specific guidance on applying AST results; reasonable extrapolations that can be made across bacterial species, infection sites, or antimicrobial agents; and the expected degree of confidence in these extrapolations. Also included are excerpts from other CLSI documents relevant to interpreting AST reports.

Based on available expertise and perceived need, this report covers the following animal species: dogs, cats, horses, cattle, pigs, and fish. These animal species represent all the veterinary breakpoints that have been approved to date by the CLSI Subcommittee on Veterinary Antimicrobial Susceptibility Testing (VAST), with the exception of poultry breakpoints for one antimicrobial agent. Interpreting AST results for chicken and turkey pathogens is not discussed in this report, although these animal species are a significant focus for antimicrobial stewardship efforts worldwide. Poultry veterinarians and laboratories handling poultry diagnostics are encouraged to consult CLSI documents VET01[3] and VET08[4] for AST guidance.

⚠️ **NOTE:**

Interpreting AST results for chicken and turkey pathogens is not discussed in this report, although these animal species are a significant focus for antimicrobial stewardship efforts worldwide.

⚠ NOTE:

Growing two or more microbes from a clinical specimen does not confirm that a polymicrobial infection is the cause of the disease.

interpretation, because it can be difficult to determine if the bacteria have taken advantage of a breached barrier or weakened host immune status to cause bacterial infection, or if the bacteria are present because of incorrect sampling or sampling of sites with normal bacterial flora like mucous membranes, skin, or the gastrointestinal tract. Lastly, growing two or more microbes from a clinical specimen does not confirm that a polymicrobial infection is the cause of the disease. It may represent a single pathogen in a mix of contaminants or a true mixed infection. Additionally, antibiotic use may alter the population of isolated bacteria. This scenario could result in recovery of only the resistant subset of a polymicrobial infection or isolation of contaminants, with the dominant or true infectious agents responding to antimicrobial therapy.

Receipt of a fresh, appropriately collected clinical specimen in suitable transport medium is essential to the laboratory's capacity to recover and identify significant pathogens. To assess the significance of bacteria in a given clinical specimen, laboratorians should review multiple aspects of the case including:

- ✓ Animal description (eg, breed, sex, age, neuter status)
- ✓ Clinical signs or other diagnostic abnormalities
- ✓ History of antimicrobial agent use
- ✓ Sampling infection site/ location of the lesion
- ✓ Type of bacteria
- ✓ Virulence factors and toxins, if any
- ✓ Possible presence of other disease or agents including anaerobic bacteria or fungal or viral agents

2.3.2 Differences Among Gram-Negative Bacteria

Antimicrobial susceptibility varies widely among gram-negative bacteria. Three main groups of gram-negative bacteria commonly isolated from animals include *Pasteurellaceae, Enterobacteriaceae*, and gram-negative nonfermenters (eg, *Pseudomonas aeruginosa*). Each group is unique in its

Related CLSI Reference Materials*

M11 **Methods for Antimicrobial Susceptibility Testing of Anaerobic Bacteria. 9th ed., 2018.** This standard provides reference methods for determining minimal inhibitory concentrations of anaerobic bacteria by agar dilution and broth microdilution.

M24 **Susceptibility Testing of Mycobacteria, *Nocardia* spp., and Other Aerobic Actinomycetes. 3rd ed., 2018.** This standard provides protocols and related quality control parameters for antimicrobial susceptibility testing of mycobacteria, *Nocardia* spp., and other aerobic actinomycetes.

M62 **Performance Standards for Antimicrobial Susceptibility Testing of Mycobacteria, *Nocardia* spp., and Other Aerobic Actinomycetes. 1st ed., 2018.** This document includes updated breakpoint and quality control tables for the Clinical and Laboratory Standards Institute susceptibility testing standard M24.

M100 **Performance Standards for Antimicrobial Susceptibility Testing. 29th ed., 2019.** This document includes updated tables for the Clinical and Laboratory Standards Institute antimicrobial susceptibility testing standards M02, M07, and M11.

VET01 **Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated From Animals. 5th ed., 2018.** This standard covers the current recommended methods for disk diffusion susceptibility testing and the reference methods for determining minimal inhibitory concentrations of aerobic bacteria by broth macrodilution, broth microdilution, and agar dilution for veterinary use.

VET02 **Development of *In Vitro* Susceptibility Testing Criteria and Quality Control Parameters for Veterinary Antimicrobial Agents. 3rd ed., 2008.** This document addresses the required and recommended data needed for selection of appropriate interpretive standards and quality control guidance for new veterinary antimicrobial agents.

VET03 **Methods for Antimicrobial Disk Susceptibility Testing of Bacteria Isolated From Aquatic Animals. 1st ed., 2006.** This document provides the most up-to-date techniques for disk diffusion susceptibility testing of aquatic species isolates, and criteria for quality control testing.

VET03/ VET04 **Performance Standards for Antimicrobial Susceptibility Testing of Bacteria Isolated From Aquatic Animals. 2nd ed., 2014.** This document provides updated tables for the Clinical and Laboratory Standards Institute antimicrobial susceptibility testing guidelines VET03-A and VET04-A2.

VET04 **Methods for Broth Dilution Susceptibility Testing of Bacteria Isolated From Aquatic Animals. 2nd ed., 2014.** This document provides the most up-to-date techniques for the determination of minimal inhibitory concentrations of aquatic bacteria by broth micro- and macrodilution, and criteria for data interpretation and quality control testing.

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* CLSI documents are continually reviewed and revised through the CLSI consensus process; therefore, readers should refer to the most current editions.

Related CLSI Reference Materials (Continued)

VET06 **Methods for Antimicrobial Susceptibility Testing of Infrequently Isolated or Fastidious Bacteria Isolated From Animals. 1st ed., 2017.** This document provides guidance for antimicrobial agent disk and dilution susceptibility testing, criteria for quality control testing, and breakpoints for fastidious and infrequently tested bacteria for veterinary use.

VET08 **Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated From Animals. 4th ed., 2018.** This document includes updated tables for the Clinical and Laboratory Standards Institute veterinary antimicrobial susceptibility testing standard VET01.

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