This document describes methods for recording and analysis of antimicrobial susceptibility test data, consisting of cumulative and ongoing summaries of susceptibility patterns of clinically significant microorganisms.

A guideline for global application developed through the Clinical and Laboratory Standards Institute consensus process.
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Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline—Fourth Edition

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Abstract

Susceptibility statistical data, consisting of the cumulative and ongoing summary of the patterns of antimicrobial susceptibility of clinically important microorganisms, are important to the practice of medicine on several levels.

If the methods used to create, record, and analyze the data are not reliable and consistent, many of the most important applications and benefits of the data will not be realized. Clinical and Laboratory Standards Institute document M39-A4—Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline—Fourth Edition is an attempt 1) to develop guidelines for clinical laboratories and data analysis software providers for the routine generation and storage of susceptibility data, and for the compilation of susceptibility statistics; and 2) to provide suggestions to clinical laboratories and clinicians for effective use of their cumulative susceptibility statistics.


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Foreword

The antimicrobial susceptibility data generated from testing individual patients’ microbial isolates are helpful if cumulative data from such tests are assembled and appropriately reported at regular intervals. For the cumulative reports to be useful and comparable with those of previous years or other institutions, data must be obtained and presented in a clear and consistent manner.

The primary aim of this document is to guide the preparation of cumulative antimicrobial susceptibility test data reports that will prove useful to clinicians in the selection of the most appropriate agents for initial empirical antimicrobial therapy. Other analyses of antimicrobial susceptibility test data may also be of significant value to clinicians, infection control personnel, epidemiologists, pharmacists, and others. These reports are often used to support antibiotic stewardship efforts. Several examples are included in M39.

Overview of Changes From M39-A3

Below is a summary of the changes in this document, which supersede the information presented in previous editions of M39. The list includes “major” changes. Other minor or editorial changes that have been made to the general formatting are not listed here.

General

M39 has been reorganized into two parts: Part I describes the routine cumulative antibiogram, and Part II describes what is referred to as the “enhanced antibiogram.” Part II includes suggestions for analyzing and presenting cumulative antibiogram data to answer specific questions about susceptibility patterns in a particular facility. These reports may not be needed on a routine basis.

During this revision, the following sections were updated and relocated to Part II:

Section 6.8.2, Supplemental Analyses of Multidrug-Resistant Organisms (now Section 12)

Section 6.8.3, Additional Data Stratification (now Section 11, Stratifying Cumulative Antibiogram Data by Various Parameters)

Section 6.8.4, Examples of Selection Criteria for Supplemental Analyses (now Section 11.1)

Section 6.8.5, Examining Percent Susceptible for Combinations of Antimicrobial Agents (now Section 13)

Section 7.3.2, Specific Locations (now Section 11, Stratifying Cumulative Antibiogram Data by Various Parameters)

Section 7.3.3, Emerging Resistance Trends (now Section 16.1)

Part I

Section 1, Scope

Added notation that those involved with antibiotic stewardship programs often use cumulative antibiogram data.
Definitions
Added definitions for antimicrobial susceptibility test interpretive categories (susceptible, susceptible-dose dependent, intermediate, resistant, nonsusceptible); line listing of antimicrobial susceptibility test data; multidrug-resistant organism.

Section 6.5.2, Selective Reporting
Expanded section and described a method that could be used to estimate the percent susceptible (%S) for drugs routinely tested but reported selectively.

Section 6.6.1, Changes in Interpretive Breakpoints (previously Section 6.6)
Expanded recommendations for handling changes in interpretive breakpoints and included a table and graphic examples that highlight the changes.

Section 6.6.2, Issues Related to Determining the Interpretation of Minimal Inhibitory Concentration Values (previously Section 6.6.1)
Added an example.

Section 6.8.1, S. pneumoniae
Modified footnotes to Streptococcus pneumoniae example of reporting %S for drugs that have both meningitis and nonmeningitis breakpoints.

Section 6.8.3, Susceptible-Dose Dependent
Added information for reporting antimicrobial agents that have susceptible-dose dependent interpretive criteria.

Section 7.2.1, Organisms
For gram negatives:
Added Klebsiella oxytoca.

Suggested that it may be useful to separate gram-negative organisms into glucose-fermenting and nonglucose-fermenting bacilli in antibiogram tables.

For anaerobes:
Added Bacteroides fragilis group (other than B. fragilis).

Section 7.3.2, Change in Drug Panel During Analysis Period (eg, Antimicrobial Agent Is Removed or Added to Routine Testing Panel)
Added suggestions for analyzing data when drugs included on a specific panel change during analysis period.

Part II
Added, updated, expanded, and relocated information contained in the following sections of the previous edition of M39:

Section 6.8.3, Additional Data Stratification
Section 6.8.4, Examples of Selection Criteria for Supplemental Analyses
Section 6.8.5, Examining Percent Susceptible for Combinations of Antimicrobial Agents

Section 7.3.2, Specific Locations
Section 7.3.3, Emerging Resistance Trends

The following represent substantive additions to the original recommendations:

x
Section 12, Supplemental Analyses of Multidrug-Resistant Organisms
Added suggestions for highlighting multidrug-resistant organisms (MDROs) on a routine cumulative antibiogram report and added example (Klebsiella pneumoniae) of a supplemental report that might be generated for MDROs.

Section 13, Examining Percent Susceptible for Combinations of Antimicrobial Agents
Moved from Part I to Part II, and revised to reflect this change.

Section 14, Analysis of Susceptibility Profiles of Select Organisms
Added new section that describes preparation of a report that lists the numbers/percent of patients who harbored an isolate of a given species with a specific resistance profile.

Section 15, Calculating Percent Susceptible on Select Groups of Organisms
Added new section that describes preparation of a report that lists the %S for all isolates within an organism group.

Section 16, Graphic Presentation of Percent Susceptible Data to Illustrate Trends in Susceptibility
Added examples to include various presentation options.

Section 17, Local Cumulative Antibiograms vs External Antibiograms (eg, Data From External Surveillance Programs)
Added new section that discusses use of local vs surveillance data and when either might be advantageous.

Additional References
Updated references.

Appendix A. Suggestions for Confirmation of Resistant (R), Intermediate (I), or Nonsusceptible (NS) Antimicrobial Susceptibility Test Results and Organism Identification
Imported updated table from CLSI document M100.¹

Appendix C. Example of Using a Line Listing to Verify Susceptibility Rates Determined by the Analysis Software
Updated example data.

Appendix D. Examples of Supplemental Analyses – Stratifying Cumulative Antibiogram Data by Various Parameters
Updated example data.

Appendix E1. Cumulative Antimicrobial Susceptibility Report Example – Antimicrobial Agents Listed Alphabetically (Hypothetical Data)
Incorporated suggestion to insert “R” in cells denoting intrinsic resistance for the drug/organism combination.

Appendix E2. Cumulative Antimicrobial Susceptibility Report Example – Antimicrobial Agents Listed by Class (Hypothetical Data)
Incorporated suggestion to insert “R” in cells denoting intrinsic resistance for the drug/organism combination.

Appendix F. Examples of Graphs to Illustrate Trends in Susceptibility
Added examples to include various presentation options.
Appendix G. Steps for Presenting Local Cumulative Antibiogram Report to Health Care Professionals
Updated primary recommendations for analysis and data to consider highlighting.

Appendix I. Glossaries of β-Lactams and Non-β-Lactams: Class and Subclass Designation and Generic Name, and Abbreviations/Routes of Administration/Drug Class for Antimicrobial Agents
Imported updated table from CLSI document M100.1

Appendix J. Intrinsic Resistance
Imported updated table from CLSI document M100.1

Key Words
Antibiogram, antimicrobial agent, cumulative antibiogram, epidemiology, resistance
Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline—Fourth Edition

1 Scope

The recommendations set forth in this document are intended to be used by individuals involved in the following:

- Analyzing and presenting antimicrobial susceptibility test data (eg, clinical microbiologists, pharmacists, physicians)
- Using cumulative antimicrobial susceptibility test data to make clinical decisions and/or participate in antibiotic stewardship programs (ASPs) (eg, clinical microbiologists, infectious disease specialists and other clinicians, infection control practitioners, pharmacists, epidemiologists, other health care personnel, and public health officials)
- Designing information systems for the storage and analysis of antimicrobial susceptibility test data (eg, LIS vendors, manufacturers of diagnostic products that include epidemiology analysis software, and manufacturers of epidemiology analysis or surveillance software)

The cumulative antimicrobial susceptibility report generated, according to recommendations presented in this guideline, may not reveal some trends in emerging resistance, and thus cannot substitute for the careful analysis of all susceptibility data derived from examining and/or analyzing all antimicrobial susceptibility test results for individual patient management. For reports intended for other purposes (eg, emergence of resistance during therapy, empirical therapy of subsequent infections), other inclusion criteria may be appropriate.

2 Introduction

This guideline presents specific recommendations for the collection, analysis, and presentation of cumulative antimicrobial susceptibility test data. Among the issues addressed are the way in which multiple isolates from the same patient should be handled, the species included or combined in a statistic, the frequency of data analysis, and the format for data presentation. This guideline also identifies additional data analysis and presentation options that may be useful to certain clinicians for specialized applications.

It is important to recognize that many of the specific recommendations presented here (eg, inclusion of only the first isolate of a given species from an individual patient during the analysis period) have been made with the primary aim of guiding clinicians in the selection of initial empirical antimicrobial therapy for infections.

The following recommendations have been made with the primary aim of preparing a report to guide clinicians in the selection of empirical antimicrobial therapy for initial infections:

- Analyze and present a cumulative antibiogram report at least annually.
- Include only final, verified test results.
- Include only species with testing data for ≥30 isolates (see Sections 6.4 and 7.2.2).
- Include only diagnostic (not surveillance) isolates (see Section 6.4).