

# 2023 Updates to CLSI M100



Erik Munson  
Marquette University  
Wisconsin Clinical Laboratory Network  
Laboratory Technical Advisory Group

The presenter states no conflict of interest and has no financial relationship to disclose relevant to the content of this presentation.

# OUTLINE

- I. Quick discussion(s) relative to major revisions
- II. Objectives of webinar

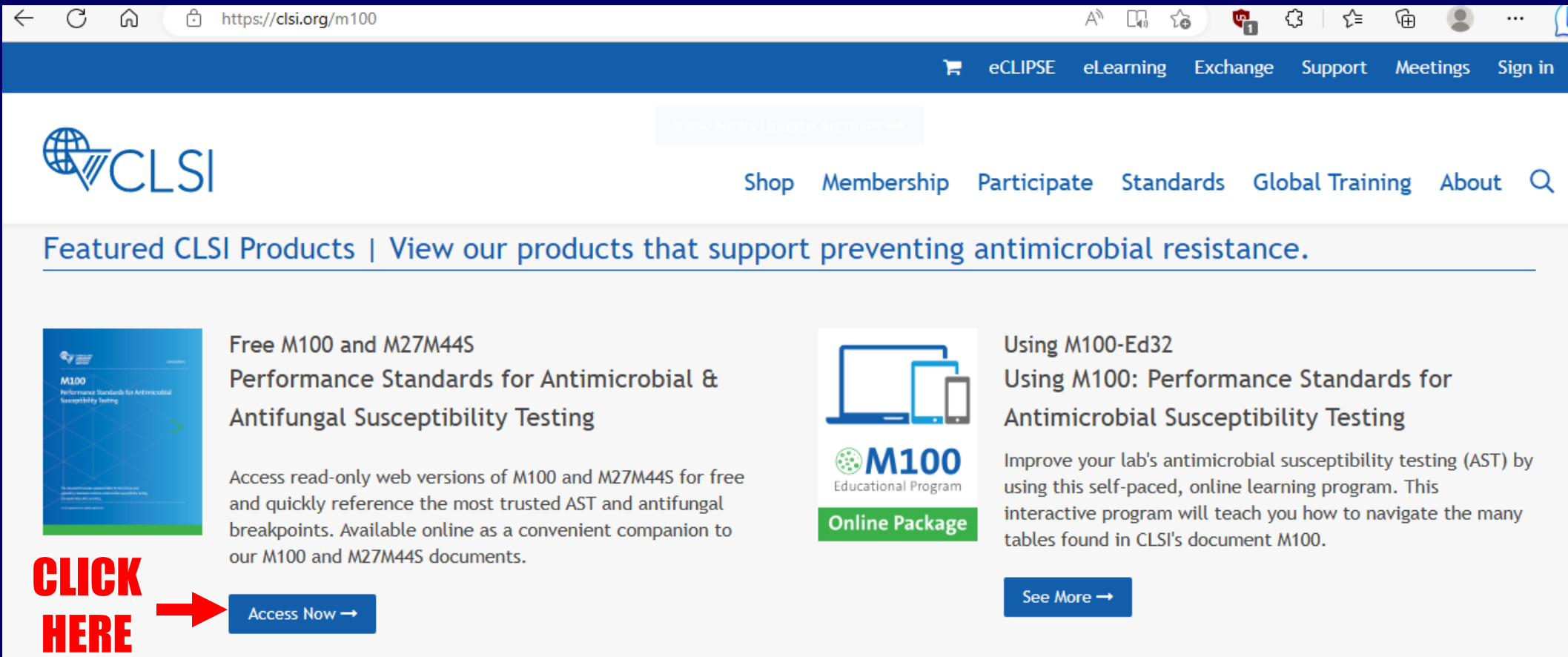
Describe significant changes relevant to pre-existing antimicrobial susceptibility breakpoints...

Describe significant changes relevant to antimicrobial susceptibility testing methodology...

Identify (new) organism/antimicrobial combinations for which susceptibility breakpoints now exist...

*as outlined in the CLSI M100-Ed33 document.*

# clsi.org/m100, then scroll down quite a bit



The screenshot shows the CLSI website at <https://clsi.org/m100>. The navigation bar includes links for eCLIPSE, eLearning, Exchange, Support, Meetings, and Sign in. The main header features the CLSI logo and a search bar. Below the header, a section titled "Featured CLSI Products | View our products that support preventing antimicrobial resistance." highlights two offerings:

- Free M100 and M27M44S Performance Standards for Antimicrobial & Antifungal Susceptibility Testing**: Access read-only web versions of M100 and M27M44S for free and quickly reference the most trusted AST and antifungal breakpoints. Available online as a convenient companion to our M100 and M27M44S documents. A red arrow points to the "Access Now →" button.
- Using M100-Ed32 Using M100: Performance Standards for Antimicrobial Susceptibility Testing**: Improve your lab's antimicrobial susceptibility testing (AST) by using this self-paced, online learning program. This interactive program will teach you how to navigate the many tables found in CLSI's document M100. A "See More →" button is located below this section.

The "M100 Educational Program" is also highlighted with a green box.

# THEN...

Not secure | em100.edaptivedocs.net/Login.aspx?\_ga=2.159766845.1498440579.1678113443-2137643289.1674665502

CLSI

Email:


[Click here](#) to use guest access

## FREE SUSCEPTIBILITY TESTING RESOURCES

Quickly reference the most trusted and updated information from CLSI.

Get Free Read-Only Access to:

- M100-Ed33
- M23-Ed5
- M23 Supplements
- M27M44S-Ed3
- M45-Ed3




Adaptive Technologies LLC

Powered By: Adaptive


# WOW!!

← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/dashboard.aspx 🔊 ⭐ 📄 ⚙ ⌵ 🗑 👤 ⋮


 CLSI


## M100 FROM CLSI!

The Reference You Reach for




to Reach a Higher Standard  
of Antibiotic Stewardship

 **Paper or  
PDF M100**

 **CLSI AST Packages!**

Welcome Guest User! Today is Thursday, April 13, 2023.

### My Library


- [CLSI M23 ED5:2018](#)
- [CLSI M23S ED1:2020](#)
- [CLSI M27M44S ED3:2022](#)
- [CLSI M45 ED3:2016](#)
- [CLSI M100 ED33:2023](#) 


### Bulletin Board


**Content Update**


- [CLSI M100 ED33:2023](#) (03/05/2023)
- [CLSI M27M44S ED3:2022](#) (08/05/2022)
- [CLSI M100 ED32:2022](#) (02/17/2022)
- [CLSI M100 ED31:2021](#) (03/26/2021)
- [CLSI M100 ED30:2020](#) (01/22/2020)
- [Revision for CLSI M100 ED29:2019 \[Table 2D \(PDF page 106\)\]. Read more.](#) (03/25/2019)


## Subscribe to M100 Plus Today!



 An Enhanced XML-based  
version of M100

 Fast and easy searching!

 User-friendly online format!

 Annotations and Bookmarks

© 2014 Edaptive Technologies LLC [Terms of Use](#) [Support/Feedback](#) | [Logout](#)


# VOILA (after hitting page-by-page icon)!!


The screenshot shows a web browser displaying the CLSI M100 Performance Standards for Antimicrobial Susceptibility Testing, 33rd Edition. The browser's address bar shows the URL: `em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&format=SPDF`. The page is titled "Page 1" and features the CLSI logo and the text "CLINICAL AND LABORATORY STANDARDS INSTITUTE®" and "33rd Edition". The main content area displays "M100 Performance Standards for Antimicrobial Susceptibility Testing". A sidebar on the left contains navigation icons: Home, Related, HTML View (highlighted with a black arrow), TOC, Top, Bottom, and Full View. The footer includes copyright information: "© 2023 CLSI | © 2023 Edaptive Technologies LLC", a link to "Terms of Use", and a "Support/Feedback | Logout" link. The page is powered by the "Edaptive Platform".


...now hit HTML View icon


# AFTER THIS, HIT THE TOC ICON


← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&format=HTML 🔊 ⭐ 📄 ⚙️ ⌵ 👤 ⋮


 CLSI


  
Home


  
Related

  
Page-by-Page

  
TOC

  
Top

  
Bottom

  
Full View

## CLSI M100-ED33:2023 Performance Standards for Antimicrobial Susceptibility Testing, 33rd Edition

Table of Contents | < Previous | Next >

March 2023


Replaces M100-Ed32


James S. Lewis II, PharmD, FIDSA	Thomas J. Kirn, Jr., MD, PhD
Melvin P. Weinstein, MD	Brandi Limbago, PhD
April M. Bobenchik, PhD, D(ABMM), FIDSA(ASCP)	Amy J. Mathers, MD, D(ABMM)
Shelley Campeau, PhD, D(ABMM)	Virginia M. Pierce, MD, FIDSA
Sharon K. Cullen, BS, RAC	Sandra S. Richter, MD, D(ABMM), FIDSA
Tanis Dingle, PhD, D(ABMM), FCCM	Michael Satlin, MD, MS
Marcelo F. Galas, BSc	Audrey N. Schuetz, MD, MPH, D(ABMM)
Romney M. Humphries, PhD, D(ABMM), FIDSA	Susan Sharp, PhD, D(ABMM), F(AAM)
	Patricia J. Simner, PhD, D(ABMM)


© 2023 CLSI | © 2023 Edaptive Technologies LLC | [Terms of Use](#) | [Support/Feedback](#) | [Logout](#) | Powered By: [Edaptive Platform](#)


# FUTZING WITH THIS...A LITTLE


← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&format=HTML 🔊 ⭐ 📄 ⚙️ ⭐ 🗂️ 👤 ⋮


 CLSI


  
Home


  
Related

  
Page-by-Page

  
TOC

  
Top

  
Bottom

  
Full View

### Table of Contents

- Abstract
- Committee Membership
- Overview of Changes
- CLSI Breakpoint Additions Since 2010
- CLSI Breakpoint Revisions Since 2010
- CLSI Archived Resources
- Summary of CLSI Processes for Establishing Breakpoints and Quality Control Ranges
- CLSI Reference Methods vs Commercial Methods and CLSI vs US Food and Drug Administration Breakpoints
- Subcommittee on Antimicrobial Susceptibility Testing Mission Statement
- Instructions for Use of Tables
- References
- Introduction to Tables 1A-1P. Antimicrobial Agents That Should Be Considered for Testing and Reporting by Microbiology Laboratories
- **Table 1A. Enterobacteriales (not including *Salmonella/Shigella*)<sup>a</sup>**
- Table 1B. *Salmonella* and *Shigella* spp.<sup>a,b</sup>
- Table 1C. *Pseudomonas aeruginosa*
- Table 1D. *Acinetobacter* spp.
- Table 1E. *Burkholderia cepacia* complex
- Table 1F. *Stenotrophomonas maltophilia*

## 2023 Performance Standards for Antimicrobial Susceptibility Testing, 33rd Edition

Table of Contents | < Previous | Next >

James S. Lewis II, PhD, FIDSA  
Melvin P. Weinstein, MD, PhD, D(ABMM),  
Sharon K. Cullen, BS, FIDSA  
Tanis Dingle, PhD, D(ABMM), FCCM  
Marcelo F. Galas, BSc  
Romney M. Humphries, PhD, D(ABMM), FIDSA

Thomas J. Kirn, Jr., MD, PhD  
Brandi Limbago, PhD  
Amy J. Mathers, MD, D(ABMM)  
Virginia M. Pierce, MD, FIDSA  
Sandra S. Richter, MD, D(ABMM), FIDSA  
Michael S. Tenover, MD, MS  
Audrey N. Schuetz, MD, MPH, D(ABMM)  
Susan Sharp, PhD, D(ABMM), F(AAM)  
Patricia J. Simner, PhD, D(ABMM)


When on "HTML" view








Table of contents (TOC) is displayed side-by-side along with the document for easy access. TOC contains page numbers and optionally the section headers, list of tables and figures. Click on the link to view associated

javascript:void(0); 2023 Edaptive Technologies LLC | Terms of Use | Support/Feedback | Logout | Powered By: Edaptive Platform

# FUTZING WITH THIS...A LITTLE

← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&sbssok=CLSI%20M100%... A 📄 ⭐ 🛠 ⚙ ⭐ 🗂 👤 ...

 CLSI

 Home  
 Related  
 Page-by-Page  
 TOC  
 Top  
 Bottom  
 Full View


**Table 1A. Enterobacterales (not including *Salmonella/Shigella*)<sup>a</sup>**

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ampicillin			
Cefazolin	Cefuroxime		
Cefotaxime or ceftriaxone <sup>b</sup>	Cefepime <sup>c</sup>		
	Ertapenem	Cefiderocol	
	Imipenem	Ceftazidime-avibactam	
	Meropenem	Imipenem-relebactam	
		Meropenem-vaborbactam	
Amoxicillin-clavulanate			
Ampicillin-sulbactam			
Piperacillin-tazobactam			
Gentamicin	Tobramycin	Plazomicin	
	Amikacin		

© 2014 Edaptive Technologies LLC | [Terms of Use](#) | [Support/Feedback](#) | [Logout](#) | Powered By: [Edaptive Platform](#)

# FUTZING WITH THIS...MORE

← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&format=SPDF 🔊 ⭐ 📄 ⚙️ ⌵ 🗑️ 👤 ⋮

 CLSI

**Table of Contents**

Pages:

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121
122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143
144	145	146	147	148	149	150	151	152	153	154
155	156	157	158	159	160	161	162	163	164	165
166	167	168	169	170	171	172	173	174	175	176
177	178	179	180	181	182	183	184	185	186	187
188	189	190	191	192	193	194	195	196	197	198
199	200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231
232	233	234	235	236	237	238	239	240	241	242
243	244	245	246	247	248	249	250	251	252	253
254	255	256	257	258	259	260	261	262	263	264
265	266	267	268	269	270	271	272	273	274	275
276	277	278	279	280	281	282	283	284	285	286
287	288	289	290	291	292	293	294	295	296	297
298	299	300	301	302	303	304	305	306	307	308

Performance Standards for Antimicrobial Susceptibility Testing, 33rd Edition

Next >

When on "Page by Page" view

360 pages


± 42

CLINICAL AND LABORATORY STANDARDS INSTITUTE®

© 2014 Edaptive Technologies LLC | Terms of Use | Support/Feedback | Logout | Powered By: Edaptive Platform

# FUTZING WITH THIS...MORE

← ↻ 🏠 ⚠ Not secure | em100.edaptivedocs.net/GetDoc.aspx?doc=CLSI%20M100%20ED33:2023&format=SPDF 🔍 ⚙ ⭐ 📄 👤 ...

 CLSI

Page 68

Home  
Related  
HTML View  
TOC  
Top  
Bottom  
Full View

CLSI ed1700 - Guest User - 04/13/2023

26

© Clinical

Table 1A  
Enterobacterales (not including inducible AmpC producers and *Salmonella/Shigella*)  
M02 and M07

Table 1A. Enterobacterales (not including inducible AmpC producers and *Salmonella/Shigella*)<sup>a</sup>

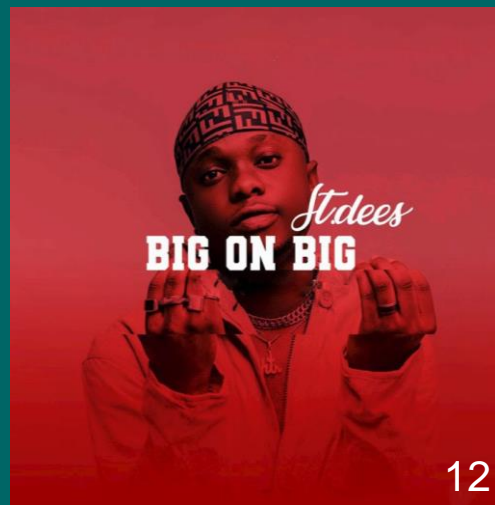
Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ampicillin			
Cefazolin	Cefuroxime		
Cefotaxime or ceftriaxone <sup>b</sup>	Cefepime <sup>c</sup>		
	Ertapenem	Cefiderocol	
	Imipenem	Ceftazidime-avibactam	
	Meropenem	Imipenem-relebactam	
		Meropenem-vaborbactam	
Amoxicillin-clavulanate			
Ampicillin-sulbactam			
Piperacillin-tazobactam			
Gentamicin	Tobramycin	Plazomicin	
	Amikacin		

M100-Ed33

© 2023 CLSI | © 2023 Edaptive Technologies LLC | Terms of Use | Support/Feedback | Logout | Powered By: Edaptive Platform



# The Really Big Ones



# THE REALLY BIG ONES #1

Table 1A  
Suggested Nonfastidious Groupings  
M02 and M07

**Table 1A. Suggested Groupings of Antimicrobial Agents Approved by the US Food and Drug Administration for Clinical Use That Should Be Considered for Testing and Reporting on Nonfastidious Organisms by Microbiology Laboratories in the United States**

GROUP A PRIMARY TEST AND REPORT	<i>Enterobacteriaceae</i>	<i>Pseudomonas aeruginosa</i>	<i>Staphylococcus</i> spp.	<i>Enterococcus</i> spp. <sup>m</sup>
	Ampicillin <sup>c</sup>	Cefazidime	Azithromycin <sup>b</sup> or clarithromycin <sup>b</sup> or erythromycin <sup>b</sup>	Ampicillin <sup>n</sup> Penicillin <sup>o</sup>
	Cefazolin <sup>d</sup>	Gentamicin Tobramycin	Clindamycin <sup>b</sup>	
	Gentamicin <sup>c</sup> Tobramycin <sup>c</sup>	Piperacillin-tazobactam	Oxacillin <sup>k,t,f,g</sup> Cefoxitin <sup>k,t</sup> (surrogate test for oxacillin)	
			Penicillin <sup>l</sup>	
			Trimethoprim- sulfamethoxazole	

# NON-FASTIDIOUS GROUPINGS

- Group A Primary test and report
- Group B Optional primary test, report selectively
- Group C Supplemental report selectively
- Group U Supplemental for urine only

# TABLES 1

Table 1A  
Suggested Nonfastidious Groupings  
M02 and M07

**Table 1A. Suggested Groupings of Antimicrobial Agents Approved by the US Food and Drug Administration for Clinical Use That Should Be Considered for Testing and Reporting on Nonfastidious Organisms by Microbiology Laboratories in the United States**

	<i>Enterobacteriaceae</i>	<i>Pseudomonas aeruginosa</i>	<i>Staphylococcus</i> spp.	<i>Enterococcus</i> spp. <sup>m</sup>
--	---------------------------	-------------------------------	----------------------------	---------------------------------------

Table 1B  
Suggested Fastidious Groupings  
M02 and M07

**Table 1B. Suggested Groupings of Antimicrobial Agents Approved by the US Food and Drug Administration for Clinical Use That Should Be Considered for Testing and Reporting on Fastidious Organisms by Microbiology Laboratories in the United States**

ST	<i>Haemophilus influenzae</i> <sup>d</sup> and <i>Haemophilus parainfluenzae</i>	<i>Neisseria gonorrhoeae</i> <sup>l</sup>	<i>Streptococcus pneumoniae</i> <sup>l</sup>	<i>Streptococcus</i> spp. β-Hemolytic Group <sup>g</sup>	<i>Streptococcus</i> spp. Viridans Group <sup>g</sup>
----	---	---	--	---	--

Table 1C  
Suggested Anaerobe Groupings  
M11

**Table 1C. Suggested Groupings of Antimicrobial Agents Approved by the US Food and Drug Administration for Clinical Use That Should Be Considered for Testing and Reporting on Anaerobic Organisms by Microbiology Laboratories in the United States**

	Gram-Negative Anaerobes	Gram-Positive Anaerobes <sup>a</sup>
--	-------------------------	--------------------------------------

# A HUGE FORMATTING CHANGE

Table 1C  
*Pseudomonas aeruginosa*  
M02 and M07

Table 1C. *Pseudomonas aeruginosa*

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution.	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ceftazidime	Imipenem	Cefiderocol	
Cefepime	Meropenem	Ceftazidime-avibactam	
Piperacillin-tazobactam		Ceftolozane-tazobactam	
		Imipenem-relebactam	
Tobramycin			
Ciprofloxacin			
Levofloxacin			
			Aztreonam
Urine Only			
	Amikacin		

Abbreviation: MDRO, multidrug-resistant organism.

NOTE: Information in black boldface type is new or modified since the previous edition.

# CRITERIA FOR INCLUSION

Agents of proven efficacy  
Acceptable *in vitro* test performance

# CRITERIA FOR ASSIGNMENT

Clinical efficacy  
Prevalence of resistance  
Minimizing emergence of resistance  
FDA clinical indications for use  
Current consensus recommendations for first-choice or alternative drugs  
Co\$t

# TABLE 1 GROUPINGS

- Tier 1 Antimicrobial agents that are appropriate for routine, primary testing and reporting
- Tier 2 Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution

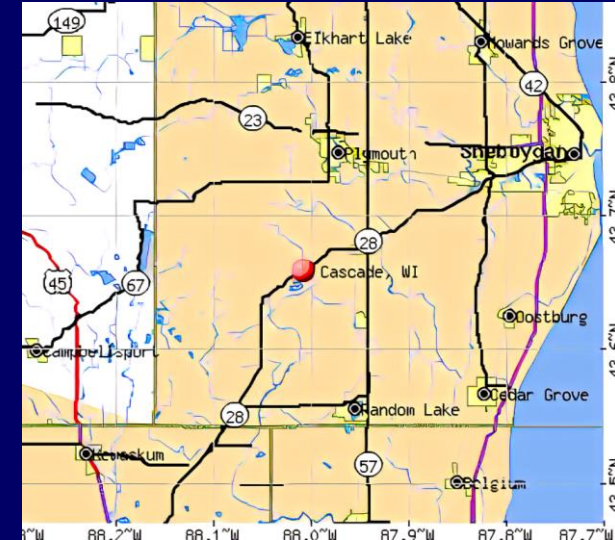
CLSI M100-Ed33, 2023



# TABLE 1 GROUPINGS

## ● Tier 3

Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution



## ● Tier 4

Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors

# REPORTING

- **Selective** Based on defined criteria unrelated to susceptibility testing data

Organism ID

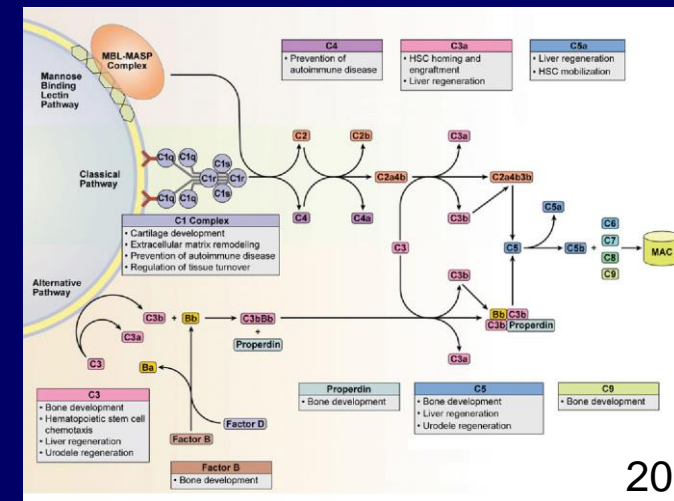
Clinical setting

Site of infection

Patient demographics

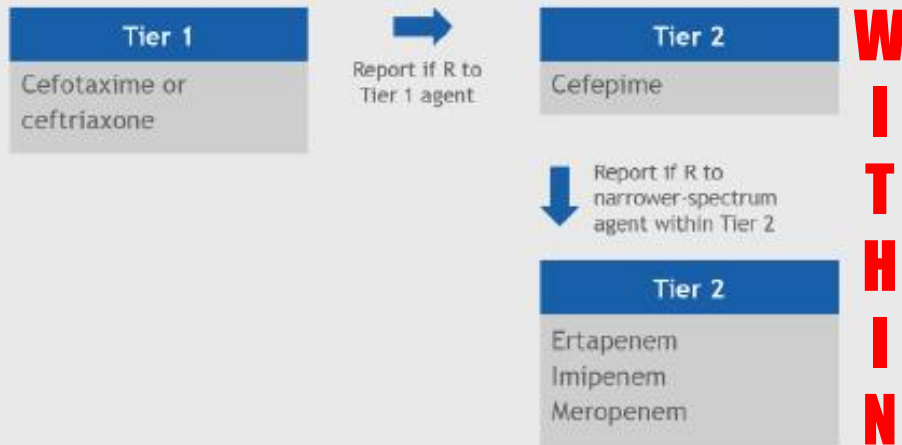
- **Cascade** Based on overall antimicrobial susceptibility profile of isolate

CLSI M100-Ed33, 2023

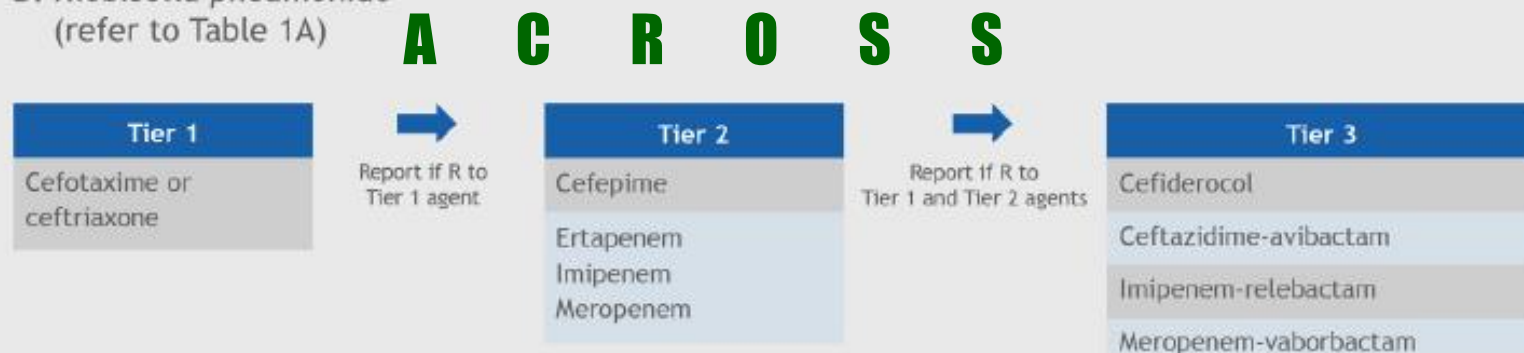


# CASCADING

## A. *Klebisella pneumoniae* (refer to Table 1A)



## B. *Klebisella pneumoniae* (refer to Table 1A)



# MORE ON FOUR

**Antimicrobial Agent Test and Report Tiers and Additional Considerations for Agents Listed in Tables 1 (Continued)**

Tier	Definition	Test	Report <sup>a</sup>	Additional Testing and Reporting Considerations
4	Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors	By request	By request	<ul style="list-style-type: none"> <li>• Test and report by clinician request due to: <ul style="list-style-type: none"> <li>– Unavailability of preferred drug for clinical use</li> <li>– Patient underlying condition, including allergies</li> <li>– Unusual susceptibility profile of the organism, including resistance to agents in Tiers 1, 2, and 3</li> <li>– Polymicrobial infection</li> </ul> </li> <li>• May also warrant testing as an epidemiological aid (eg, testing ceftazidime for Enterobacterales to indicate potential extended-spectrum <math>\beta</math>-lactamase production; see Table 3A).</li> </ul>

# URINE OR YER OUT

Table 1C  
*Pseudomonas aeruginosa*  
M02 and M07

Table 1C. *Pseudomonas aeruginosa*

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution.	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ceftazidime	Imipenem	Cefiderocol	
Cefepime	Meropenem	Ceftazidime-avibactam	
Piperacillin-tazobactam		Ceftolozane-tazobactam	
		Imipenem-relebactam	
Tobramycin			
Ciprofloxacin			
Levofloxacin			
			Aztreonam
Urine Only			
	Amikacin		

Abbreviation: MDRO, multidrug-resistant organism.

NOTE: Information in black boldface type is new or modified since the previous edition.

# NEW TABLES 1

Table 1A  
Enterobacterales (not including inducible AmpC producers and *Salmonella/Shigella*)  
M02 and M07

Table 1A. Enterobacterales (not including inducible AmpC producers and *Salmonella/Shigella*)<sup>a</sup>

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ampicillin			
Cefazolin	Cefuroxime		
Cefotaxime or ceftriaxone <sup>b</sup>	Cefepime <sup>c</sup>		
	Ertapenem	Cefiderocol	
	Imipenem	Ceftazidime-avibactam	
	Meropenem	Imipenem-relebactam	
		Meropenem-vaborbactam	
Amoxicillin-clavulanate			
Ampicillin-sulbactam			
Piperacillin-tazobactam			
Gentamicin	Tobramycin	Plazomicin	
	Amikacin		
Ciprofloxacin			
Levofloxacin			
Trimethoprim-sulfamethoxazole			
	Cefotetan		
	Cefoxitin		
	Tetracycline <sup>d</sup>		
			Aztreonam
			Ceftaroline <sup>b</sup>

# NEW TABLES 1

Table 1B  
*Salmonella* and *Shigella* spp.  
M02 and M07

Table 1B. *Salmonella* and *Shigella* spp.<sup>a,b</sup>

Tier 1: Antimicrobial agents that are appropriate for routine, primary testing and reporting	Tier 2: Antimicrobial agents that are appropriate for routine, primary testing but may be reported following cascade reporting rules established at each institution	Tier 3: Antimicrobial agents that are appropriate for routine, primary testing in institutions that serve patients at high risk for MDROs but should only be reported following cascade reporting rules established at each institution	Tier 4: Antimicrobial agents that may warrant testing and reporting by clinician request if antimicrobial agents in other tiers are not optimal because of various factors
Ampicillin			
Ciprofloxacin			
Levofloxacin			
Trimethoprim-sulfamethoxazole			
Cefotaxime or ceftriaxone			Ertapenem <sup>c</sup> Imipenem <sup>c</sup> Meropenem <sup>c</sup>
	Azithromycin <sup>d</sup>		
			Tetracycline <sup>e</sup>

Abbreviation: MDRO, multidrug-resistant organism.

## Footnotes

- Table 2A should be used for interpreting antimicrobial susceptibility testing results for *Salmonella* and *Shigella* spp.
- WARNING:** For *Salmonella* spp. and *Shigella* spp., aminoglycosides, first- and second-generation cephalosporins, and cephamycins may appear active *in vitro* but are not effective clinically and should not be reported as susceptible. Routine susceptibility testing is not indicated for nontyphoidal *Salmonella* spp. isolated from intestinal sources. However, susceptibility testing is indicated for all *Shigella* isolates. When fecal isolates of *Salmonella* and *Shigella* spp. are tested, only ampicillin, a fluoroquinolone, and trimethoprim-sulfamethoxazole should be reported routinely. In addition, for extraintestinal isolates of *Salmonella* spp., a third-generation cephalosporin should be tested and reported. Azithromycin may be

# HERE'S THE REST I

- 1C *Pseudomonas aeruginosa*
- 1D *Acinetobacter* spp.
- 1E *Burkholderia cepacia* complex
- 1F *Stenotrophomonas maltophilia*
- 1G Other non-Enterobacterales
- 1H *Staphylococcus* spp.
- 1I *Enterococcus* spp.

# HERE'S THE REST II

- 1J *Haemophilus influenzae* and *Haemophilus parainfluenzae*
- 1K *Neisseria gonorrhoeae*
- 1L *Streptococcus pneumoniae*
- 1M *Streptococcus* spp.  $\beta$ -hemolytic Group
- 1N *Streptococcus* spp. Viridans Group
- 1O Gram-Negative Anaerobes
- 1P Gram-Positive Anaerobes

no *N. meningitidis*

# NOT IN TABLES 1

**Antimicrobial Agent Test and Report Designations and Additional Considerations for Agents Not Listed in Tables 1**

Designation	Definition	Test	Report <sup>a</sup>	Additional Testing and Reporting Considerations
Other	Antimicrobial agents with established clinical breakpoints designated by an * in Tables 2 that are generally not candidates for testing and reporting in the United States	By request	By request	<p>Test and report only by clinician request and only following consultation with the antimicrobial stewardship team and other relevant institutional stakeholders to ensure appropriateness of the request.</p> <p>Agents with an “Other” designation may not reflect current consensus recommendations for first-choice and alternative drugs for the specific organism or organism group.</p>
Inv.	Antimicrobial agents that are investigational for the organism group designated by “Inv.” in Tables 2 have not yet been approved by the FDA for use in the United States.	By request	By request	<p>Test and report only by clinician request and only following consultation with the antimicrobial stewardship team and other relevant institutional stakeholders to ensure appropriateness of the request. These agents would likely be clinically available for compassionate use only.</p>

Abbreviations: FDA, US Food and Drug Administration; UTI, urinary tract infection.

# THE REALLY BIG ONES #2

Organism	Method	Gentamicin Previous			Gentamicin New		
		S	I	R	S	I	R
Enterobacterales	BMD	≤ 4	8	≥ 16	≤ 2	4	≥ 8
	DD	≥ 15	13-14	≤ 12	≥ 18	15-17	≤ 14

Organism	Method	Tobramycin Previous			Tobramycin New		
		S	I	R	S	I	R
Enterobacterales	BMD	≤ 4	8	≥ 16	≤ 2	4	≥ 8
	DD	≥ 15	13-14	≤ 12	≥ 17	13-16	≤ 12

Organism	Method	Amikacin Previous			Amikacin New		
		S	I	R	S	I	R
Enterobacterales	BMD	≤ 16	32	≥ 64	≤ 4	8	≥ 16
	DD	≥ 17	15-16	≤ 14	≥ 20	17-19	≤ 16

CLSI M100-Ed32, 2022; M100-Ed33, 2023

# WISCONSIN SURVEILLANCE DATA

● *Enterobacter cloacae*

Year	Percentage Susceptible	
	Gentamicin	Tobramycin
2018	99.3	99.3
2019	100	100

Previous

≤ 4	8	≥ 16
-----	---	------

MIC	Number of Isolates by Agent	
	Gentamicin	Tobramycin
≤ 2	593	591
4	2	4
8		1
16	1	1
>16		
32		
>32	1	

“Red” shading indicates decreased susceptibility

Cumulative frequency distribution

# WISCONSIN SURVEILLANCE DATA

● *Klebsiella pneumoniae*

Year	Percentage Susceptible	
	Gentamicin	Tobramycin
2018	97.7	97.7
2019	98.9	98.9

Previous

≤ 4	8	≥ 16
-----	---	------

MIC	Number of Isolates by Agent	
	Gentamicin	Tobramycin
≤ 2	669	669
4	7	7
8		8
16	4	1
>16		2
32	5	
>32	2	

“Red” shading indicates decreased susceptibility

Cumulative frequency distribution

# WISCONSIN SURVEILLANCE DATA

● *Proteus mirabilis*

Year	Percentage Susceptible	
	Gentamicin	Tobramycin
2016	91.4	92.1
2017	93.1	94.0
2018	92.4	92.7
2019	89.1	89.1
2020	94.4	95.5
2021	95.0	95.4
2022	95.8	96.2

Previous

≤ 4	8	≥ 16
-----	---	------

MIC	Number of Isolates by Agent	
	Gentamicin	Tobramycin
≤ 2	1850	1843
4	5	23
8	27	46
16	38	53
>16		34
32	53	
>32	26	

“Red” shading indicates decreased susceptibility

Cumulative frequency distribution

# WISCONSIN SURVEILLANCE DATA

● *Escherichia coli*

Year	Percentage Susceptible	
	Gentamicin	Tobramycin
2016	93.1	93.1
2017	93.4	94.6
2018	93.9	94.8
2019	91.9	93.5
2020	95.2	96.2
2021	94.2	96.9
2022	92.1	94.5

Previous

≤ 4	8	≥ 16
-----	---	------

MIC	Number of Isolates by Agent	
	Gentamicin	Tobramycin
≤ 2	2329	2318
4	3	47
8	8	58
16	10	39
>16		34
32	40	
>32	106	

“Red” shading indicates decreased susceptibility

Cumulative frequency distribution

# WISCONSIN SURVEILLANCE DATA

- Organism cumulative antibiogram before and after

Organism	Percentage Susceptible			
	Gentamicin		Tobramycin	
	Previous	New	Previous	New
<i>Enterobacter cloacae</i>	99.7	99.3	99.7	99.0
<i>Klebsiella pneumoniae</i>	98.4	97.4	98.4	97.4
<i>Proteus mirabilis</i>	92.8	92.5	93.3	92.2
<i>Escherichia coli</i>	93.4	93.3	94.8	92.9

Previous New

≤ 4	8	≥ 16	≤ 2	4	≥ 8
-----	---	------	-----	---	-----

# OVERCALLING SUSCEPTIBILITY?

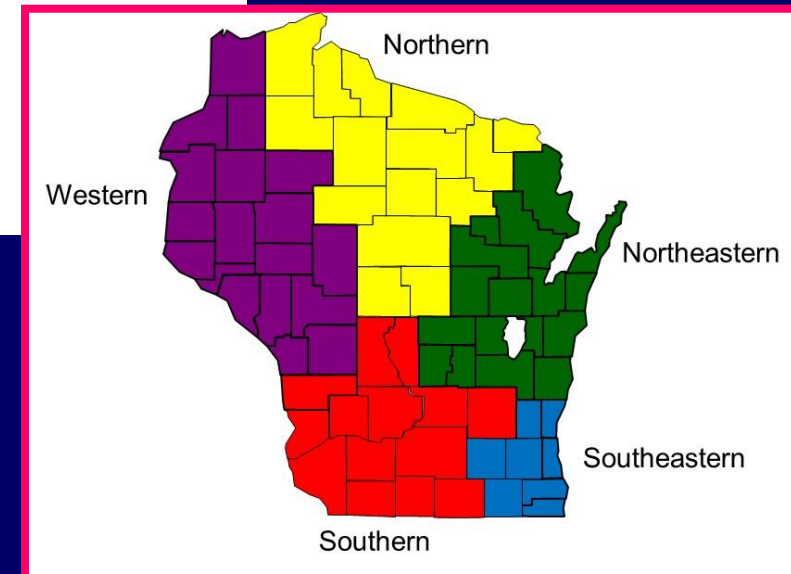
Organism	Method	Ciprofloxacin Previous			Ciprofloxacin New		
		S	I	R	S	I	R
Enterobacterales	BMD	≤ 1	2	≥ 4	≤ 0.25	0.5	≥ 1
<i>P. aeruginosa</i>	BMD	≤ 1	2	≥ 4	≤ 0.5	1	≥ 2

Organism	Method	Levofloxacin Previous			Levofloxacin New		
		S	I	R	S	I	R
Enterobacterales	BMD	≤ 2	4	≥ 8	≤ 0.5	1	≥ 2
<i>P. aeruginosa</i>	BMD	≤ 2	4	≥ 8	≤ 1	2	≥ 4

CLSI M100 28th ed., 2018; M100 29th ed., 2019

## Surveillance of Fluoroquinolone Resistance in Wisconsin: Geographic Variation and Impact of Revised CLSI Breakpoints

Giovanna Lazzerini; Stephen C. Lavey; Barry C. Fox, MD;



*E. coli*

1.5-3.2% reduced fluoroquinolone susceptibility

*P. mirabilis*

2.6-6.3% reduced fluoroquinolone susceptibility

*P. aeruginosa*

4.5-5.1% reduced fluoroquinolone susceptibility

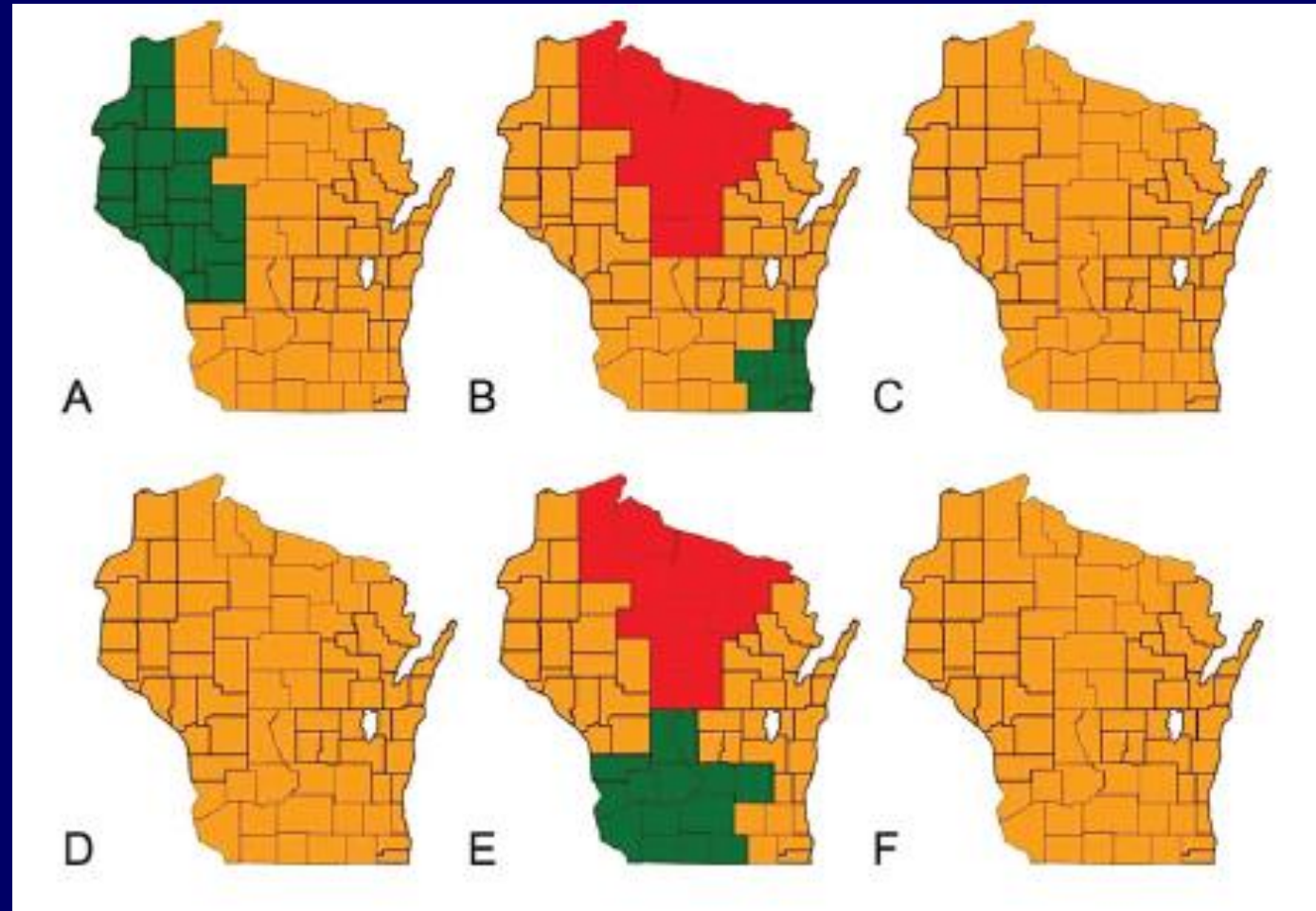
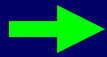
# CIPROFLOXACIN

*E. coli*

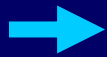
*P. mirabilis*

*P. aeruginosa*

CLSI  
previous



CLSI  
new



Clin Med Res. 20:81-88; 2022

# WISCONSIN SURVEILLANCE DATA

● *Escherichia coli*

Region	Percentage Susceptible			
	Gentamicin		Tobramycin	
	Previous	New	Previous	New
Northern	95.2	95.2	96.7	95.5
Northeastern	94.6	94.5	96.2	93.4
Southern	92.5	92.3	93.3	91.8
Southeastern	91.3	91.1	91.5	90.7
Western	93.3	93.3	95.6	93.3
WISCONSIN	93.4	93.3	94.8	92.9

Previous New

≤ 4	8	≥ 16	≤ 2	4	≥ 8
-----	---	------	-----	---	-----

# WISCONSIN SURVEILLANCE DATA

● *Proteus mirabilis*

Region	Percentage Susceptible			
	Gentamicin		Tobramycin	
	Previous	New	Previous	New
Northern	90.4	90.0	90.4	89.3
Northeastern	94.1	93.6	94.8	92.6
Southern	90.1	89.8	90.9	90.1
Southeastern	96.3	96.3	96.8	96.3
Western	90.8	90.8	91.5	90.8
WISCONSIN	92.8	92.5	93.3	92.2

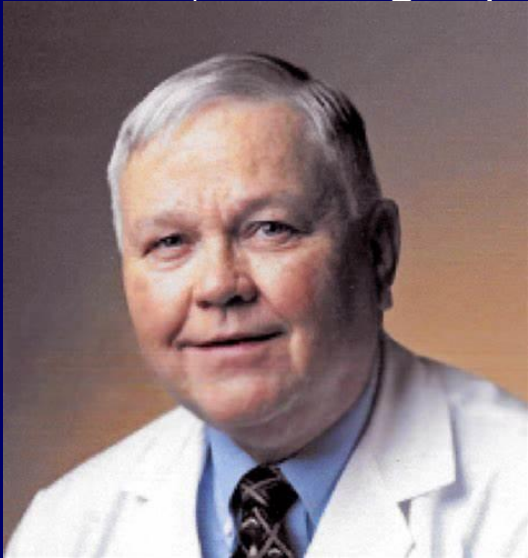
Previous New

≤ 4	8	≥ 16	≤ 2	4	≥ 8
-----	---	------	-----	---	-----

# WISCONSIN SURVEILLANCE DATA

● *Proteus mirabilis*

Region	Percentage Susceptible			
	Gentamicin		Tobramycin	
	Previous	New	Previous	New
Northern	90.4	90.0	90.4	89.3
Northeastern	94.1	93.6	94.8	92.6
Central	90.1	89.8	90.9	90.1
Western	96.3	96.3	96.8	96.3
Southern	90.8	90.8	91.5	90.8
WISCONSIN	92.8	92.5	93.3	92.2



Previous			New		
≤ 4	8	≥ 16	≤ 2	4	≥ 8

# WHY???

## Piperacillin-Tazobactam Breakpoints for Enterobacterales



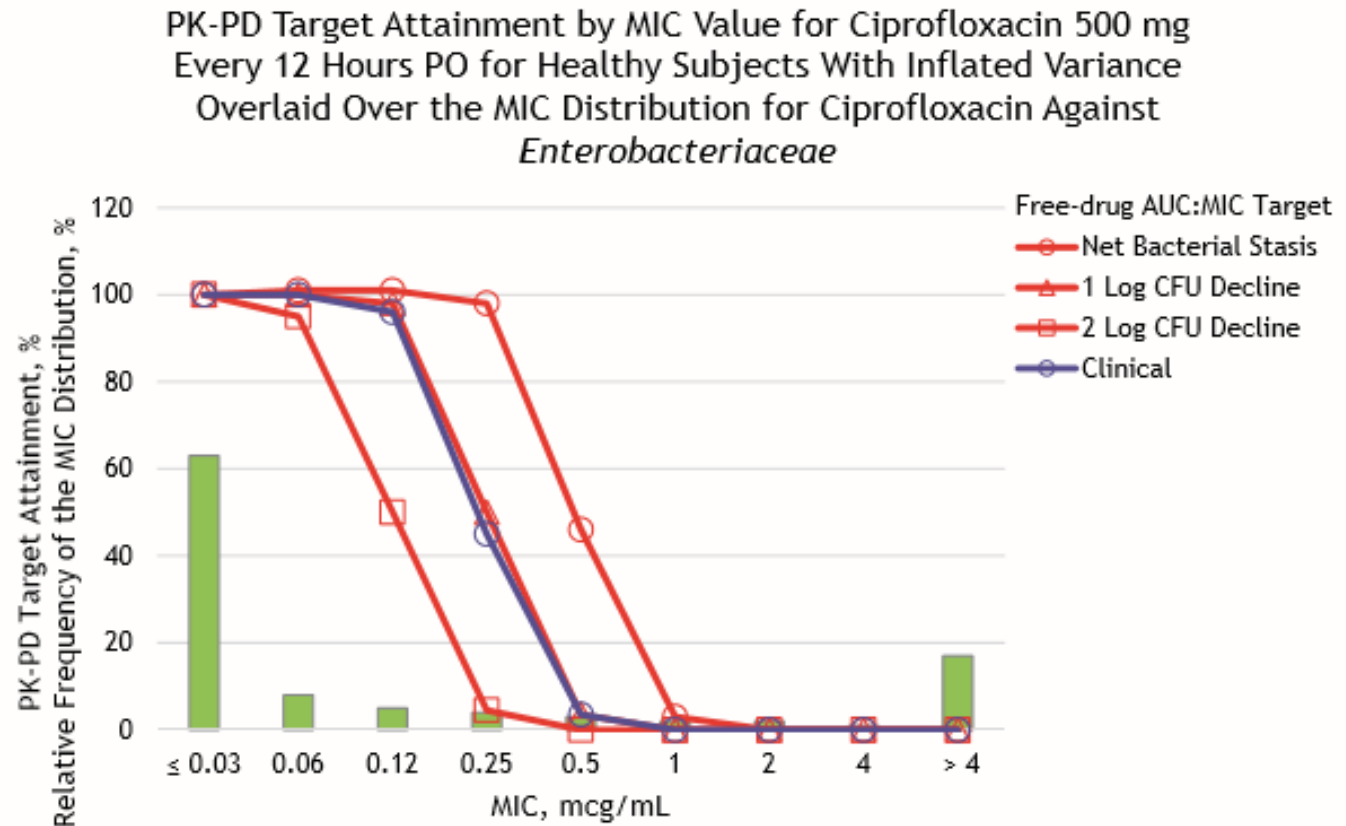
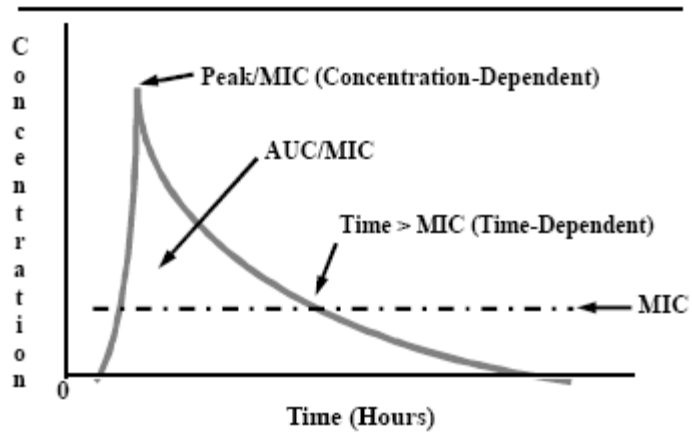
CLSI rationale document MR14  
February 2022

Romney M. Humphries, PhD, D(ABMM), FIDSA  
Vanderbilt University Medical Center  
USA

Table 2A. Enterobacterales (Continued)

Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm				Interpretive Categories and MIC Breakpoints, µg/mL				Comments
		S	SDD	I	R	S	SDD	I	R	
AMINOGLYCOSIDES										
(54) WARNING: For <i>Salmonella</i> spp. and <i>Shigella</i> spp., aminoglycosides may appear active <i>in vitro</i> but are not effective clinically and should not be reported as susceptible.										
(55) Breakpoints for gentamicin, tobramycin, and amikacin are based on population distributions of various species, PK/PD target attainment analyses with an end point of net bacterial stasis and limited clinical data. Clinical outcomes data for aminoglycosides as monotherapy for systemic infections are limited and have resulted in worse treatment outcomes (for infections outside of the urinary tract) compared with other therapies. Combination therapy for most indications other than UTIs should be considered. Consultation with an infectious diseases specialist is recommended.										

# MORE-SOPHISTICATED MODELING



PLEASE STAND BY

# PLAZOMICIN IV

- FDA approval in 2018
- Complicated UTI (including pyelonephritis) when limited options available

*Escherichia coli*

*Enterobacter cloacae*

*Klebsiella pneumoniae*

*Proteus mirabilis*

- Stable to hydrolysis by majority of aminoglycoside-modifying enzymes (AME)
- Isolates carrying 16S rRNA methyltransferases exhibit high MIC for plazomicin

# PLAZOMICIN IV

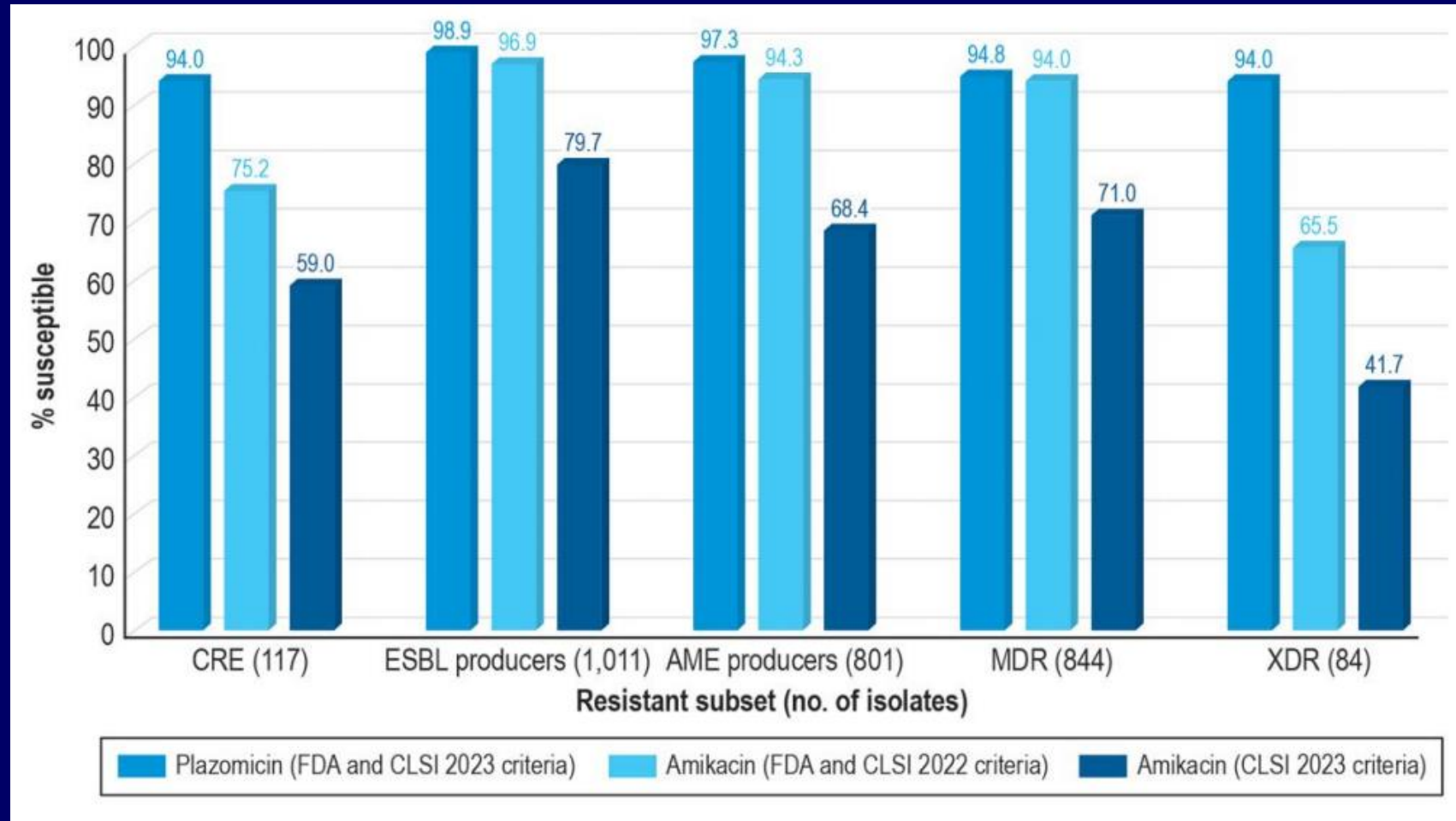
Table 2A. Enterobacterales (Continued)

Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm				Interpretive Categories and MIC Breakpoints, µg/mL				Comments
		S	SDD	I	R	S	SDD	I	R	
AMINOGLYCOSIDES										
Gentamicin	10 µg	≥ 18	-	15-17^	≤ 14	≤ 2	-	4^	≥ 8	(56) Breakpoints are based on a dosage regimen of 7 mg/kg parenterally administered every 24 h.
Tobramycin	10 µg	≥ 17	-	13-16^	≤ 12	≤ 2	-	4^	≥ 8	(57) Breakpoints are based on a dosage regimen of 7 mg/kg parenterally administered every 24 h.
Amikacin	30 µg	≥ 20	-	17-19^	≤ 16	≤ 4	-	8^	≥ 16	(58) Breakpoints are based on a dosage regimen of 15 mg/kg parenterally administered every 24 h.
Plazomicin	30 µg	≥ 18	-	15-17^	≤ 14	≤ 2	-	4^	≥ 8	(59) Breakpoints are based on a dosage regimen of 15 mg/kg every 24 h over 30 minutes.

...but not for *Morganellaceae*



# PLAZOMICIN IV



**MDR:** non-susceptible to at least 1 drug from  $\geq 3$  classes

**XDR:** susceptible to  $\leq 2$  classes

Open Forum Infect Dis. 10:ofad058; 2023

# THE REALLY BIG ONES #3

Organism	Method	Tobramycin Previous			Tobramycin New		
		S	I	R	S	I	R
<i>P. aeruginosa</i>	BMD	≤ 4	8	≥ 16	≤ 1	2	≥ 4
	DD	≥ 15	13-14	≤ 12	≥ 19	13-18	≤ 12

Organism	Method	Amikacin Previous			Amikacin New		
		S	I	R	S	I	R
<i>P. aeruginosa</i>	BMD	NO	C	H	A	N	GE
	DD	NO	C	H	A	N	GE

CLSI M100-Ed32, 2022; M100-Ed33, 2023

# WISCONSIN SURVEILLANCE DATA

● *Pseudomonas aeruginosa*



Year	Percentage Susceptible	
	Gentamicin	Tobramycin
2016	99.1	99.5
2017	97.2	97.2
2018	99.3	99.0
2019	97.2	98.9
2020	98.6	99.4
2021	99.2	99.2
2022	98.0	98.8

Previous for both

≤ 4	8	≥ 16
-----	---	------

MIC	Number of Isolates by Agent	
	Gentamicin	Tobramycin
≤ 2	1888	1942
4	51	7
8	13	6
16	6	4
>16		13
32	1	
>32	13	

Cumulative  
frequency  
distribution

# WHY???

## Piperacillin-Tazobactam Breakpoints for Enterobacterales



CLSI rationale document MR14  
February 2022

Table 2B-1. *Pseudomonas aeruginosa* (Continued)

Antimicrobial Agent	Disk Content	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm			Interpretive Categories and MIC Breakpoints, µg/mL			Comments
		S	I	R	S	I	R	
AMINOGLYCOSIDES								
(28) Breakpoints for tobramycin and amikacin are based on population distributions of various species, PK/PD target attainment analyses with an end point of net bacterial stasis, and limited clinical data. Clinical outcomes data for aminoglycosides as monotherapy for systemic infections are limited and have resulted in worse treatment outcomes (for infections outside of the urinary tract) compared with other therapies. Combination therapy for most indications other than urinary tract infections should be considered. Consultation with an infectious diseases specialist is recommended.								
Tobramycin	10 µg	≥19	13-18^	≤12	≤1	2^	≥4	(29) Breakpoints are based on a dosage regimen of 7 mg/kg parenterally administered every 24 h.  (30) Tobramycin does not predict susceptibility to gentamicin.
Amikacin (U) <sup>b</sup>	30 µg	≥17	15-16^	≤14	≤16	32^	≥64	(31) Breakpoints are based on a dosage regimen of 15 mg/kg parenterally administered every 24 h.

# THE REALLY BIG ONES #3

Organism	Method	Pip/tazo Previous			Pip/tazo New		
		S	I	R	S	I	R
<i>P. aeruginosa</i>	BMD	≤ 16	32-64	≥ 128	≤ 16	32	≥ 64
	DD	≥ 21	15-20	≤ 14	≥ 22	18-21	≤ 17

Organism	Method	Tobramycin Previous			Tobramycin New		
		S	I	R	S	I	R
<i>P. aeruginosa</i>	BMD	≤ 4	8	≥ 16	≤ 1	2	≥ 4
	DD	≥ 15	13-14	≤ 12	≥ 19	13-18	≤ 12

Organism	Method	Amikacin Previous			Amikacin New		
		S	I	R	S	I	R
<i>P. aeruginosa</i>	BMD	NO	C	H	A	N	GE
	DD	NO	C	H	A	N	GE

CLSI M100-Ed32, 2022; M100-Ed33, 2023

# WISCONSIN SURVEILLANCE DATA

● *Pseudomonas aeruginosa*

Year	Percentage Susceptible
	Piperacillin/tazobactam
2016	93.4
2017	92.7
2018	88.1
2019	92.5
2020	93.4
2021	90.2
2022	91.4

Previous

≤ 16	32-64	≥ 128
------	-------	-------

MIC	Number of Isolates by Agent
	Piperacillin-tazobactam
≤ 8	1650
16	157
32	68
64	26
128	29
256	26
>256	16

“Red” shading indicates resistance

Cumulative frequency distribution

# WISCONSIN SURVEILLANCE DATA

● *Pseudomonas aeruginosa*, piperacillin/tazobactam

Parameter	Previous	New
% susceptible	91.6	91.6
% intermediate	4.8	3.4
% resistant	3.6	4.9

Region	Percentage Resistance	
	Previous	New
Northern	2.7	2.7
Northeastern	3.5	4.3
Southern	3.8	4.9
Southeastern	5.5	8.5
Western	1.8	3.3

Previous      New

≤ 16	32-64	≥ 128
------	-------	-------

≤ 16	32	≥ 64
------	----	------

# PROBABILITY OF TARGET ATTAINMENT

- Modern methods of PK/PD evaluation determined low PTA for piperacillin-tazobactam when utilizing current CLSI breakpoints (normal renal function)
- No studies revealed high PTA with MIC > 16 µg/mL

Table 5. Summary of Studies Investigating Piperacillin-Tazobactam PK and PD Data

Dosage	Infusion Time	MIC With ≥ 90% PTA <sup>a</sup>
3.375 g every 6 h	30 min	≤ 8 µg/mL <sup>10-12</sup>
4.5 g every 6 h	30 min	≤ 8 µg/mL <sup>12-15</sup>
3.375 g every 8 h	4 h	≤ 8 µg/mL <sup>14-17</sup>
4.5 g every 8 h	4 h	≤ 8 µg/mL <sup>12-15</sup>
4.5 g every 12 h	4 h	≤ 16 µg/mL <sup>12,14,17,18</sup>
4.5 g every 18 h	3 h	≤ 16 µg/mL <sup>12,13,18,19</sup>





# Old Business

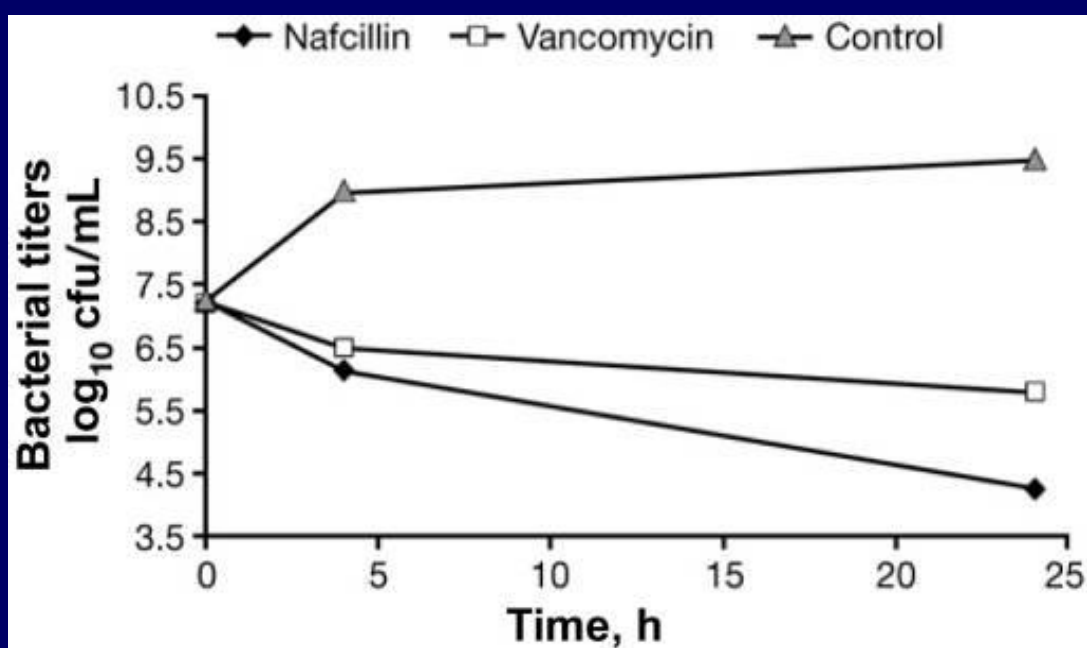


# WE ARE ON A ROLL

Organism	Phenotypic Methods for Detection of Methicillin (Oxacillin)-Resistant <i>Staphylococcus</i> spp.				
	Cefoxitin MIC	Cefoxitin disk diffusion	Oxacillin MIC	Oxacillin disk diffusion	Oxacillin salt agar
<i>S. aureus</i>	Yes (16-20 h)	Yes (16-18 h)	Yes (24 h)	No	Yes (24 h)
<i>S. lugdunensis</i>	Yes (16-20 h)	Yes (16-18 h)	Yes (24 h)	No	No
<i>S. epidermidis</i>	No	Yes (24 h)	Yes (24 h)	Yes (16-18 h)	No
<i>S. pseudintermedius</i>	No	No	Yes (24 h)	Yes (16-18 h)	No
<i>S. schleiferi</i>	No	No	Yes (24 h)	Yes (16-18 h)	No
<i>Staphylococcus</i> spp. (not listed above or not identified to the species level)	No	Yes <sup>a</sup> (24 h)	Yes <sup>a</sup> (24 h)	No	No

Abbreviations: h, hour(s); MIC, minimal inhibitory concentration; MRS, methicillin (oxacillin)-resistant staphylococci; PBP2a, penicillin-binding protein 2a.

<sup>a</sup> For isolates that fall into the category of *Staphylococcus* spp (not listed above or not identified to the species level) from serious infections for which the oxacillin MICs are 1-2 µg/mL, tests for *mecA* or PBP2a should be considered, because these are the most definitive tests for detection of methicillin (oxacillin) resistance (see comment [19]). Recent data suggest that the cefoxitin disk diffusion test may not perform reliably for all species (eg, *S. haemolyticus*) that fall into the category of “*Staphylococcus* spp. (not listed above or not identified to the species level).”<sup>5</sup>



AMERICAN  
SOCIETY FOR  
MICROBIOLOGY

Journal of  
Clinical Microbiology®

COMMENTARY



## Use of Rapid Diagnostics To Manage Pediatric Bloodstream Infections? You Bet Your ASP!

Mark D. Gonzalez,<sup>a</sup> Melanie L. Yarbrough<sup>b</sup>

<sup>a</sup>Department of Pathology and Laboratory Services, Children's Healthcare of Atlanta, Atlanta, Georgia, USA

<sup>b</sup>Department of Pathology & Immunology, Washington University School of Medicine, St. Louis, Missouri, USA

# POSITIVE BLOOD CULTURE BOTTLE



- Resistance in GNR can be multi-factorial; full phenotypic approach may be desirable
- Little standardization; very few laboratories report

J Clin Microbiol. 56:e01678-17; 2018

# THEY'VE BEEN TRYING THIS...I

JOURNAL OF CLINICAL MICROBIOLOGY, Mar. 1979, p. 347-350  
0095-1137/79/03-0347/04\$02.00/0

Vol. 9, No. 3

## Standardization of Direct Susceptibility Test for Blood Cultures

DALE FAY†\* AND JEAN E. OLDFATHER

*Riverside Methodist Hospital, Columbus, Ohio 43214*

Received for publication 17 December 1978

Insufficient data are available to establish the reliability of direct disk diffusion susceptibility tests performed utilizing positive blood culture broth as inoculum. When *Staphylococcus aureus* ATCC 25923, *Escherichia coli* ATCC 25922, and *Pseudomonas aeruginosa* ATCC 27853 were used, 0.03 ml of turbid overnight blood culture broth was found to produce zone diameters closely approximating the size of diameters obtained by a standardized method. Results of direct (0.03 ml of inoculum) and standardized susceptibility tests were then compared for 116 positive blood cultures (1,069 individual disk comparisons). There were 1,011 test agreements (94.6%). There were also 48 (4.5%) minor discrepancies (change between sensitive and intermediate or between intermediate and resistant) and 10 (0.9%) major discrepancies (change between sensitive and resistant). The major discrepancies were randomly distributed among several organisms and antibiotics. Discrepancies occurred most frequently in the more clinically acceptable direction; i.e., in 79.3% the direct test indicted greater resistance than the standardized test. These data establish that 0.03 ml of turbid overnight blood culture broth produces results which compare closely to those obtained with standard methods, and in practice yield direct susceptibility results with a clinically acceptable level of reliability.

CHRISTOPHER CROGG



# TWO DROPS

TABLE 2. *Organisms included in the clinical comparison of the direct and standardized susceptibility tests*

Organism	No. of strains tested	Discrepancies		Agreements
		Major	Minor	
<i>E. coli</i>	46	2	22	390
<i>Klebsiella</i>	16	2	12	130
<i>Proteus mirabilis</i>	8	2	3	67
<i>Providencia stuartii</i>	1	0	1	8
<i>Citrobacter diversus</i>	1	0	0	9
<i>Citrobacter freundii</i>	1	0	1	8
<i>Enterobacter aerogenes</i>	3	0	1	26
<i>Enterobacter cloacae</i>	3	2	1	24
<i>Enterobacter agglomerans</i>	1	0	0	9
<i>Serratia marcescens</i>	3	0	0	27
<i>P. aeruginosa</i>	4	0	0	36
<i>Pseudomonas</i> species	2	0	2	16
<i>Bordetella pertussis</i>	1	0	0	9
<i>Acinetobacter calcoaceticus</i>	1	0	0	9
<i>S. aureus</i>	12	0	0	120
<i>Staphylococcus epidermidis</i>	8	2	4	74
<i>Enterococcus</i>	3	0	1	29
Group D <i>Streptococcus</i> (not <i>Enterococcus</i> )	1	0	0	10
Viridans <i>Streptococcus</i>	1	0	0	10

TABLE 3. *Distribution of discrepancies between direct and standardized susceptibility tests by antibiotic*

Antibiotic	No. of comparisons	Discrepancies		
		Total	Major	Minor
Ampicillin	116	4 (3.8) <sup>a</sup>	1	3
Carbenicillin	91	4 (4.3)	0	4
Cephalothin	116	16 (13.8)	2	14
Chloramphenicol	116	6 (5.2)	3	3
Clindamycin	25	0	0	0
Colistin	91	6 (6.6)	2	4
Erythromycin	25	0	0	0
Gentamicin	116	0	0	0
Kanamycin	116	1 (0.8)	0	1
Methicillin	25	1 (4.0)	0	1
Penicillin	25	3 (12.0)	1	2
Streptomycin	91	9 (9.9)	0	9
Tetracycline	116	8 (6.9)	1	7

Major (0.9%): shift between sensitive and resistant

Minor (4.5%): shift between sensitive and intermediate  
shift between intermediate and resistant

# THEY'VE BEEN TRYING THIS...II

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, Nov. 1981, p. 696-698  
0066-4804/81/110696-03\$02.00/0

Vol. 20, No. 5

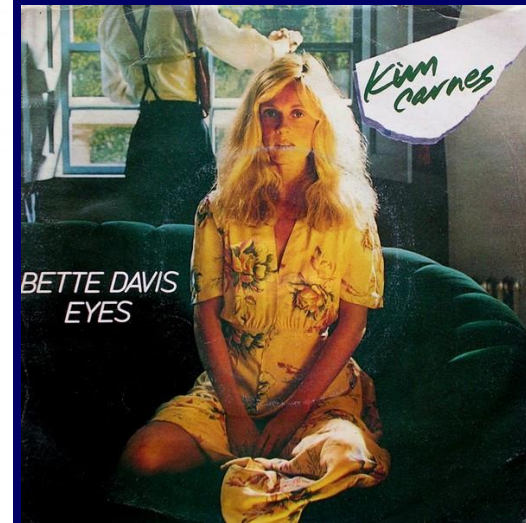
## Evaluation of a Direct Blood Culture Disk Diffusion Antimicrobial Susceptibility Test

GARY V. DOERN,<sup>†\*</sup> DAVID R. SCOTT,<sup>‡</sup> ABDEL L. RASHAD, AND KENNETH S. KIM

*Department of Clinical Pathology, University of Oregon Health Sciences Center, Portland, Oregon 97201*

Received 10 April 1981/Accepted 6 August 1981

A total of 556 unique blood culture isolates of nonfastidious aerobic and facultatively anaerobic bacteria were examined by direct and standardized disk susceptibility test methods (4,234 antibiotic-organism comparisons). When discrepancies which could be accounted for by the variability inherent in disk diffusion susceptibility tests were excluded, the direct method demonstrated 96.8% overall agreement with the standardized method. A total of 1.6% minor, 1.5% major, and 0.1% very major discrepancies were noted.



# SIX DROPS

**TABLE 1. Comparison of direct blood culture disk susceptibility test results with standardized disk susceptibility test results**

Antibiotic	No. of discrepancies <sup>a</sup> for:						
	n = 171		n = 166		n = 219		
	Gram-negative bacilli <sup>b</sup>		Streptococci <sup>c</sup>		Staphylococci and micrococci <sup>d</sup>		Totals
Kanamycin	0, 8, 66	(56.7)	NT		NT		0, 8, 66 (56.7)
Gentamicin	0, 1, 3	(97.7)	NT		NT		0, 1, 3 (97.7)
Tobramycin	0, 1, 5	(96.5)	NT		NT		0, 1, 5 (96.5)
Amikacin	0, 4, 17	(87.7)	NT		NT		0, 4, 17 (87.7)
Carbenicillin	0, 6, 14	(88.3)	NT		NT		0, 6, 14 (88.3)
Ampicillin	1, 3, 12	(90.6)	0, 2, 11	(92.2)	NT		1, 5, 23 (91.4)
Cephalothin	0, 4, 50	(68.5)	0, 0, 6	(96.4)	0, 0, 0	(100)	0, 4, 56 (89.2)
Tetracycline	0, 1, 43	(74.3)	1, 5, 15	(87.4)	1, 2, 2	(97.7)	2, 8, 60 (87.4)
Chloramphenicol	0, 1, 13	(91.8)	0, 0, 9	(94.6)	0, 3, 3	(97.2)	0, 4, 25 (94.8)
Erythromycin	NT		1, 1, 9	(93.4)	0, 2, 3	(97.7)	1, 3, 12 (95.8)
Clindamycin	NT		0, 0, 6	(96.4)	0, 2, 0	(99.1)	0, 2, 6 (97.9)
Penicillin	NT		0, 2, 14	(90.4)	0, 5, 25	(96.3)	0, 7, 39 (88.1)
Methicillin	NT		NT		1, 11, 6	(91.8)	1, 11, 6 (91.8)
Totals	1, 29, 223	(83.6)	2, 10, 70	(92.9)	2, 25, 39	(95.7)	5, 64, 332 (90.5)

Very Major Error; Major Error; Minor Error; (percentage concordance)

Antimicrob Agents Chemother. 20:696-698; 1981

# THEY'VE BEEN TRYING THIS...III

JOURNAL OF CLINICAL MICROBIOLOGY, Sept. 1984, p. 473-477  
0095-1137/84/090473-05\$02.00/0  
Copyright © 1984, American Society for Microbiology

Vol. 20, No. 3

## Rapid Antimicrobial Susceptibility Testing of Isolates from Blood Cultures by Direct Inoculation and Early Reading of Disk Diffusion Tests

MARIE B. COYLE,<sup>1,2\*</sup> LEE ANNE MCGONAGLE,<sup>3</sup> JAMES J. FLORDE,<sup>4</sup> CARLA R. CLAUSEN,<sup>5</sup> AND FRITZ D. SCHOENKNECHT<sup>3</sup>

*Clinical Microbiology Division, University of Washington,<sup>1</sup> and University Hospital,<sup>3</sup> Seattle, Washington 98195; Harborview Medical Center, Seattle, Washington 98104;<sup>2</sup> Seattle Veterans Administration Medical Center, Seattle, Washington 98108;<sup>4</sup> and Childrens Orthopedic Hospital and Medical Center, Seattle, Washington 98105<sup>5</sup>*

Received 13 January 1984/Accepted 24 May 1984

Disk diffusion tests, inoculated directly from positive blood cultures, were evaluated for accuracy of reading zone diameters after 4- and 6-h and overnight incubation. In comparisons with results from standard disk diffusion tests, the 4-h results were in agreement for 83% of tests with gram-positive organisms and 64% of tests with gram-negative organisms. When minor discrepancies were ignored, the 4-h readings were in agreement for 98% of the tests with gram-positive organisms and 95% of the tests with gram-negative organisms. After 6 h of incubation, 91% of the tests with gram-positive organisms and 86% of the tests with gram-negative organisms agreed with standard results. The agreement was 99% for tests with both gram-positive and gram-negative organisms when minor discrepancies were excluded. Very major discrepancies occurred in two tests (0.1%) with gram-positive organisms and were not observed in tests with gram-negative organisms. The frequencies of major discrepancies were 3.5% after 4 h, 0.6% after 6 h, and 0.7% after overnight incubation. Ampicillin and cephalothin tests with *Escherichia coli* and *Klebsiella* spp. accounted for 81% of the major discrepancies in tests with gram-negative organisms. Oxacillin tests accounted for more than half of the major discrepancies in tests with staphylococci. The results of this study, which did not include the newer antibiotics, indicate that direct susceptibility tests from blood cultures read after 6 h of incubation are more reliable than 4-h results and produce less than 1% major errors in comparisons with standard susceptibility tests.



# READING 'EM EARLY

TABLE 1. Percentage of isolates with direct tests read after 4 or 6 h

Blood culture isolate	No. of isolates	% Read after:	
		4 h	6 h <sup>a</sup>
Gram positive			
<i>S. aureus</i>	60	22	63
Coagulase-negative staphylococci	87	3	21
Beta-hemolytic streptococci	30	37	87
Enterococci	21	19	52
Pneumococci	21	10	38
Viridans streptococci	14	0	0
Total for gram positive	233	14	44
Gram negative			
<i>E. coli</i>	84	52	85
<i>Klebsiella spp.</i>	38	40	76
<i>Enterobacter spp.</i>	12	42	92
<i>P. aeruginosa</i>	11	0	64
Others <sup>b</sup>	25	36	60
Total for gram negative	170	43	78

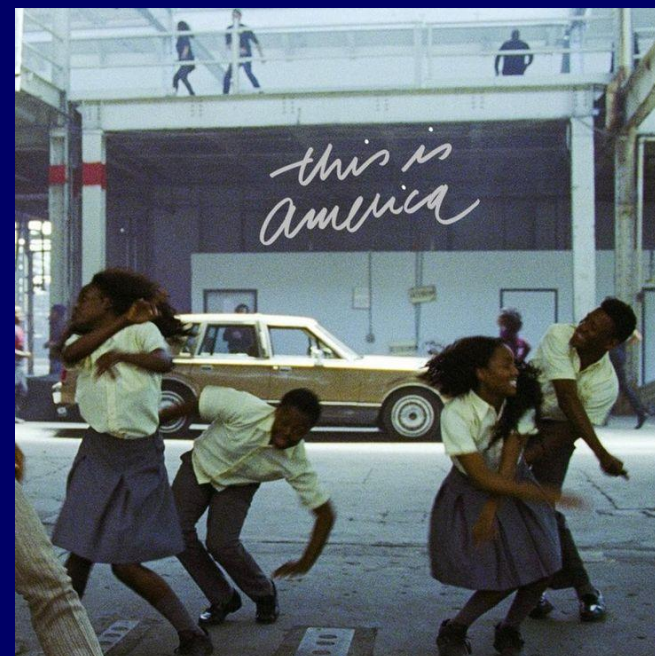
TABLE 2. Discrepancies from direct tests compared with standardized tests

Isolate type, time incubated	No. of tests	No. of discrepancies			Overall agreement (%)
		Very major (%)	Major (%)	Minor (%)	
Gram positive					
4 h	216	1 (0.5)	3 (1.4)	32 (14.8)	83.3
6 h	494	0	3 (0.6)	39 (7.9)	91.4
Overnight	1,307	1 (0.07)	8 (0.6)	65 (5.0)	94.3
Gram negative					
4 h	361	0	17 (4.7)	114 (31.6)	63.7
6 h	438	0	3 (0.7)	59 (13.5)	85.8
Overnight	762	0	6 (0.8)	73 (9.6)	89.6

# RESULTS

**TABLE 3** Resolved performance of direct-from-blood-culture disk diffusion method at 18 h, by antibiotic

Drug	No. of isolates		% CA	No. (%) of:		
	S	R		VME	ME	mE
Amikacin	45	13	96.7	0 (0)	0 (0)	2 (3.3)
Amoxicillin-clavulanate	9	17	88.9	0 (0)	1 (11.1)	2 (7.4)
Ampicillin ←	6	9	93.3	0 (0)	0 (0)	1 (6.7)
Aztreonam ←	21	28	94.3	0 (0)	0 (0)	3 (5.7)
Cefazolin	5	18	73.1	0 (0)	2 (40.0)	5 (19.2)
Cefepime	41	17	91.7	0 (0)	0 (0)	5 (8.3)
Cefoxitin	10	15	85.2	0 (0)	1 (10.0)	3 (11.1)
Ceftazidime ←	25	31	89.8	0 (0)	0 (0)	6 (10.2)
Ceftriaxone ←	16	29	87.5	0 (0)	2 (12.5)	4 (8.3)
Ciprofloxacin ←	26	27	96.6	0 (0)	0 (0)	1 (1.7)
Ertapenem	22	12	83.3	0 (0)	0 (0)	7 (16.7)
Gentamicin	39	18	95.0	0 (0)	1 (2.6)	2 (3.3)
Imipenem	34	21	68.3	0 (0)	3 (8.8)	15 (25.0)
Levofloxacin	33	25	91.7	0 (0)	1 (3.0)	3 (5.0)
Meropenem ←	37	19	84.7	0 (0)	1 (2.7)	8 (13.6)
Minocycline	29	11	80.0	0 (0)	0 (0)	9 (20.0)
Piperacillin-tazobactam	23	30	83.3	0 (0)	0 (0)	10 (16.7)
Tigecycline	35	3	87.2	0 (0)	0 (0)	5 (12.8)
Tobramycin ←	39	17	93.2	0 (0)	0 (0)	4 (6.8)
Trimethoprim-sulfamethoxazole ←	17	30	95.8	0 (0)	0 (0)	2 (4.2)



# RESULTS

**TABLE 3** Resolved performance of cod-culture disk diffusion method at 6 h, 18 h, by antibiotic

Drug	% CA	No. (%) of:	
		VME	ME
Amikacin	96.7	0 (0)	0 (0)
Amoxicillin-clavulanate	88.9	0 (0)	1 (11.1)
Ampicillin	93.3	0 (0)	0 (0)
Aztreonam	94.3	0 (0)	0 (0)
Cefazolin	73.1	0 (0)	2 (40.0)
Cefepime	91.7	0 (0)	0 (0)
Cefoxitin	85.2	0 (0)	1 (10.0)
Ceftazidime	89.8	0 (0)	0 (0)
Ceftriaxone	87.5	0 (0)	2 (12.5)
Ciprofloxacin	96.6	0 (0)	0 (0)
Ertapenem	83.3	0 (0)	0 (0)
Gentamicin	95.0	0 (0)	1 (2.6)
Imipenem	68.3	0 (0)	3 (8.8)
Levofloxacin	91.7	0 (0)	1 (3.0)
Meropenem	84.7	0 (0)	1 (2.7)
Minocycline	80.0	0 (0)	0 (0)
Piperacillin-tazobactam	83.3	0 (0)	0 (0)
Tigecycline	87.2	0 (0)	0 (0)
Tobramycin	93.2	0 (0)	0 (0)
Trimethoprim-sulfamethoxazole	95.8	0 (0)	0 (0)

**TABLE 5** Resolved performance of direct-from-blood-culture disk diffusion method at 6 h, by antibiotic

Drug	No. of isolates		% CA	No. (%) of:		
	S	R		VME	ME	mE
Amikacin	45	13	62.2	3 (23.1)	2 (4.4)	12 (26.7)
Amoxicillin-clavulanate	9	17	60.0	0 (0)	1 (11.1)	9 (36.0)
Ampicillin	6	9	69.2	0 (0)	1 (16.7)	3 (23.1)
Aztreonam	21	28	84.2	0 (0)	1 (4.8)	5 (13.2)
Cefazolin	5	18	66.7	1 (5.6)	2 (40.0)	6 (25.0)
Cefepime	41	17	75.6	0 (0)	4 (9.8)	6 (13.3)
Cefoxitin	10	15	68.0	0 (0)	1 (10.0)	7 (28.0)
Ceftazidime	25	31	65.9	0 (0)	4 (16.0)	11 (25.0)
Ceftriaxone	16	29	77.3	0 (0)	3 (18.8)	7 (15.9)
Ciprofloxacin	24	27	57.1	0 (0)	1 (4.2)	16 (39.0)
Ertapenem	22	12	73.7	0 (0)	2 (9.1)	8 (21.1)
Gentamicin	39	18	95.6	0 (0)	0	2 (4.4)
Imipenem	34	21	46.7	0 (0)	6 (17.6)	18 (40.0)
Levofloxacin	33	25	75.6	0 (0)	1 (3.0)	10 (22.2)
Meropenem	36	19	52.3	0 (0)	9 (25.0)	11 (25.6)
Minocycline	29	11	65.9	0 (0)	0	12 (29.3)
Piperacillin-tazobactam	22	30	64.4	2 (6.7)	4 (18.2)	11 (25.0)
Tigecycline	35	3	45.7	0 (0)	3 (8.6)	16 (45.7)
Tobramycin	39	17	95.6	0 (0)	0	2 (4.4)
Trimethoprim-sulfamethoxazole	17	30	86.4	1 (3.3)	2 (11.8)	3 (6.8)







**Table 3E-1. Test for Performing Disk Diffusion Directly From Positive Blood Culture Broth**

Test	Direct Disk Diffusion
Test method	Disk diffusion using positive blood culture broth
Organism group	Enterobacterales and <i>Pseudomonas aeruginosa</i>
Medium	MHA
Antimicrobial concentration	Standard disk contents for the antimicrobials are detailed in Table 3E-2 (Enterobacterales) and Table 3E-3 ( <i>P. aeruginosa</i> )
Inoculum	Positive blood culture broth with gram-negative bacilli, used within 8 hours of flagging positive by the blood culture system
Test procedure	<ol style="list-style-type: none"> <li>1. Invert blood culture bottle 5-10 times to thoroughly mix.</li> <li>2. Sterilize the top of the bottle with an alcohol wipe (allow to dry) and insert 20-gauge venting needle into the blood culture bottle.</li> <li>3. Dispense 4 drops of blood culture broth onto an MHA plate. As a purity check, use an inoculated blood agar plate streaked for isolation.</li> <li>4. Spread blood culture broth across the entire surface of the MHA plate using a sterile cotton swab.</li> <li>5. Repeat this procedure by streaking twice more, rotating the plate approximately 60 degrees each time to ensure an even distribution of inoculum.</li> <li>6. Leave the lid ajar for 3-5 minutes (ideally) but no more than 15 minutes.</li> <li>7. Dispense antimicrobial disks onto the surface of the inoculated MHA plate.</li> <li>8. Press each disk down to ensure complete contact with the agar surface.</li> <li>9. Invert the plate and place in the incubator within 15 minutes of disks being applied.</li> </ol>
Incubation conditions	35°C ± 2°C; ambient air
Incubation length	8-10 hours or 16-18 hours (refer to Tables 3E-2 and 3E-3 for antimicrobial agent-specific incubation lengths)
Results	<ol style="list-style-type: none"> <li>1. Examine the blood agar purity plate to ensure pure growth.</li> <li>2. Examine the test plate to ensure confluent lawn of growth appropriate to read disk zone tests per M02.<sup>1</sup></li> <li>3. Measure the zone diameters according to routine disk diffusion recommendations in M02.<sup>1</sup></li> <li>4. Report results using the interpretive categories and zone diameter breakpoints in Table 3E-2 or Table 3E-3 if the gram-negative bacillus tested is confirmed to be an Enterobacterales or <i>P. aeruginosa</i>, respectively. If species is identified as another organism, do not interpret or report results.</li> </ol>

Daily or weekly QC; *E. coli* ATCC 25922, *P. aeruginosa* ATCC 27853

# TABLE 3E-2

Table 3E-2. Enterobacterales (Continued)

Test Report Group	Antimicrobial Agent	Disk Content	Read Times, hours	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm				Comments
				S	SDD	I	R	
PENICILLINS								
	Ampicillin	10 µg	8-10	≥ 16	-	12-15	≤ 11	(3) Results of ampicillin testing can be used to predict results for amoxicillin.  (4) Breakpoints are based on an ampicillin dosage regimen of 2 g parenterally administered every 4-6 h or an amoxicillin dosage regimen of 1-2 g parenterally administered every 6 h.
			16-18	≥ 17	-	14-16	≤ 13	
CEPHEMS (PARENTERAL) (Including cephalosporins I, II, III, and IV. Please refer to Glossary I.)								
	Ceftriaxone	30 µg	8-10	≥ 23	-	20-22	≤ 19	(5) Breakpoints are based on a dosage regimen of 1 g administered every 24 h.
			16-18	≥ 23	-	20-22	≤ 19	
	Ceftazidime	30 µg	8-10	≥ 21	-	18-20	≤ 17	(6) Breakpoints are based on a dosage regimen of 1 g administered every 8 h.
			16-18	≥ 21	-	18-20	≤ 17	
MONOBACTAMS								
	Aztreonam	30 µg	8-10	≥ 21	-	18-20	≤ 17	(7) Breakpoints are based on a dosage regimen of 1 g administered every 8 h.
			16-18	≥ 21	-	18-20	≤ 17	
AMINOGLYCOSIDES								
	Tobramycin	10 µg	8-10	≥ 15	-	13-14	≤ 12	
			16-18	≥ 15	-	13-14	≤ 12	
FOLATE PATHWAY ANTAGONISTS								
	Trimethoprim-sulfamethoxazole	1.25/23.75 µg	8-10	-	-	-	-	
			16-18	≤ 16	-	11-15	≤ 10	

Abbreviations: I, intermediate; MIC, minimal inhibitory concentration; R, resistant; S, susceptible; SDD, susceptible-dose dependent.

# NEWBIES

Agent	Concentration	Incubation time (hours)	Zone Diameters (mm)		
			S	I	R
Meropenem	10 µg	8-10	≥ 22	20-21	≤ 19
		16-18	≥ 22	19-21	≤ 18

Agent	Concentration	Incubation time (hours)	Zone Diameters (mm)		
			S	I	R
Ciprofloxacin*	5 µg	8-10	≥ 21	18-20	≤ 17
		16-18	≥ 21	18-20	≤ 17

\* not for *Salmonella* spp.

CLSI M100-Ed33, 2023

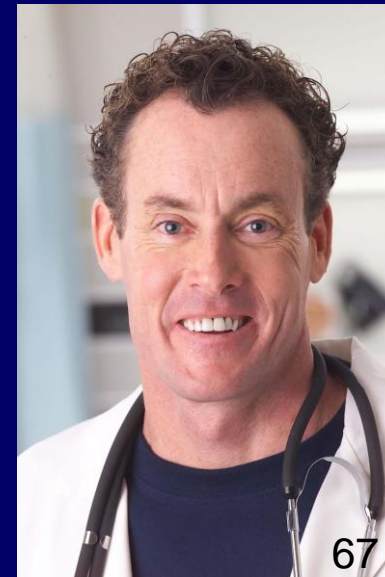






Table 3E-3. Zone Diameter Disk Diffusion Breakpoints for *Pseudomonas aeruginosa* Direct From Blood Culture

General Comments

(1) The dosage regimens shown in the Comments column below are necessary to achieve plasma drug exposure (in adults with normal renal and hepatic function) on which breakpoints were derived. When new breakpoints are implemented, it is strongly recommended that laboratories share this information with infectious diseases practitioners, pharmacists, pharmacy and therapeutics committees, infection prevention committees, and the antimicrobial stewardship team.

(2) For additional testing and reporting recommendations, refer to Table 2B-1.

NOTE: Information in boldface type is new or modified since the previous edition.

Test Report Group	Antimicrobial Agent	Disk Content	Read Times, hours	Interpretive Categories and Zone Diameter Breakpoints, nearest whole mm				Comments
				S	SDD	I	R	
CEPHEMS (PARENTERAL) (Including cephalosporins I, II, III, and IV. Please refer to Glossary I.)								
	Ceftazidime	30 µg	8-10	-	-	-	-	(3) Breakpoints are based on a dosage regimen of 1 g administered every 6 h or 2 g administered every 8 h.
			16-18	≥ 18	-	15-17	≤ 14	
CARBAPENEMS								
	Meropenem	10 µg	8-10	≥ 19	-	16-18	≤ 15	(4) Breakpoints are based on a dosage regimen of 1 g administered every 8 h.
			16-18	≥ 19	-	16-18	≤ 15	
AMINOGLYCOSIDES								
	Tobramycin	10 µg	8-10	≥ 15	-	13-14	≤ 12	
			16-18	≥ 15	-	13-14	≤ 12	
FLUOROQUINOLONES								
	Ciprofloxacin	5 µg	8-10	≥ 23	-	18-22	≤ 17	(5) Breakpoints are based on a dosage regimen of 400 mg administered parenterally every 8 h.
			16-18	≥ 25	-	19-24	≤ 18	

Abbreviations: I, intermediate; R, resistant; S, susceptible; SDD, susceptible-dose dependent.



# Table 1



# AmpC DEREPRESSION DURING Rx



*Serratia* spp.  
*Providencia* spp.  
Indole-positive *Proteus*  
*Citrobacter* spp.  
*Enterobacter* spp.

*Serratia* spp. ++  
*Providencia* spp. ++  
*Morganella* spp. ++  
*Citrobacter freundii* +++  
*Enterobacter cloacae* +++  
yes, *Klebsiella aerogenes* +++  
*Yersinia* spp.



CLSI M100-Ed33, 2023



Table 2



# SELECTED THOUGHTS I

- Accuracy and reproducibility of cefiderocol susceptibility testing affected by Fe concentration and inoculum preparation (mfg. variability)

Broth microdilution

Disk diffusion

- Poor efficacy of amoxicillin vs. ampicillin; *Shigella*
- Clinical partners may request identification of ESBL or carbapenemase
- Gemifloxacin tested only on *K. pneumoniae*

CLSI M100-Ed33, 2023

# SELECTED THOUGHTS II

- Discourage levofloxacin monotherapy for *Stenotrophomonas maltophilia*
- *Haemophilus parainfluenzae* HTM (and broth)  
*Haemophilus influenzae* HTM (and broth)  
MH-F agar/broth
- Clinical partners may request detection of ESBL or carbapenemase
- Gemifloxacin tested only on *K. pneumoniae*

# SELECTED THOUGHTS III

- *Streptococcus pneumoniae* from CSF:

Penicillin	MIC method
Ceftriaxone	MIC method
Cefotaxime	MIC method
Meropenem	MIC method
Vancomycin	MIC or disk diffusion method
- *Streptococcus pneumoniae* from other sites:
  - Oxacillin disk diffusion method
  - Follow with  $\beta$ -lactam MIC method if  $\leq 19$  mm
- Levofloxacin susceptibility can predict moxi, gemifloxacin susceptibility

CLSI M100-Ed33, 2023



# Table 3



# TABLE 3B

Tables 3B and 3B-1  
CarbaNP Test for Suspected Carbapenemase Production and Modifications When Using  
MIC Breakpoints Described in M100-S20 (January 2010)

Table 3B. CarbaNP Test for Suspected Carbapenemase Production in Enterobacterales and *Pseudomonas aeruginosa*<sup>1-7</sup>

Tables 3B and 3B-1  
CarbaNP Test for Suspected Carbapenemase Production and Modifications When Using  
MIC Breakpoints Described in M100-S20 (January 2010)

Table 3B-1. Modifications of Table 3B When Using MIC Breakpoints for Carbapenems Described in  
M100-S20 (January 2010)<sup>1-5</sup>

Table 3B  
CarbaNP Test for Suspected Carbapenemase Production

Table 3B. CarbaNP Test for Suspected Carbapenemase Production in Enterobacterales and *Pseudomonas aeruginosa*<sup>1-7</sup>

M100-E

“No change in the interpretation of carbapenem susceptibility test results is necessary for CarbaNP-positive isolates. Such testing is not currently recommended for routine use.”

CLSI M100-Ed31, 2021; Ed33, 2023

# TABLE 3C

Tables 3C and 3C-1  
Modified Carbapenem Inactivation Methods and Modifications When Using  
MIC Breakpoints Described in M100-S20 (January 2010)

Table 3C. Modified Carbapenem Inactivation Methods for Suspected Carbapenemase Production in  
Enterobacterales and *Pseudomonas aeruginosa*<sup>1-6</sup>

Tables 3C and 3C-1  
Modified Carbapenem Inactivation Methods and Modifications When Using  
MIC Breakpoints Described in M100-S20 (January 2010)

Table 3C-1. Modifications of Table 3C When Using MIC Breakpoints for Carbapenems Described in  
M100-S20 (January 2010)

Table 3C  
Modified Carbapenem Inactivation Methods

Table 3C. Modified Carbapenem Inactivation Methods for Suspected Carbapenemase Production in  
Enterobacterales and *Pseudomonas aeruginosa*<sup>1-6</sup>

“No change in the interpretation of carbapenem susceptibility test results is necessary for mCIM positive and/or eCIM results. mCIM with or without eCIM testing is not currently recommended for routine use.”

CLSI M100-Ed31, 2021; Ed33, 2023

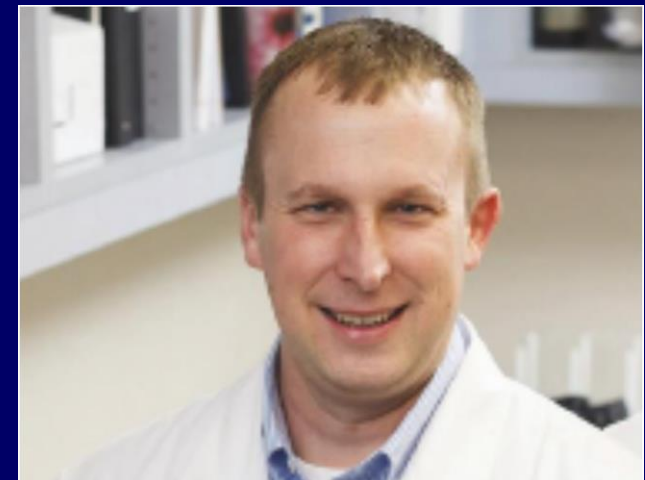


## Table 4



# SOME DD QC ADDITIONS/REVISIONS

<i>E. coli</i> NCTC 13353	ceftibuten-ledaborbactam ceftibuten
<i>N. gonorrhoeae</i> ATCC 49226	gentamicin



CLSI M100-Ed33, 2023



# Table 5



# SOME MIC QC ADDITIONS/REVISIONS

<i>E. coli</i> ATCC 25922	ceftibuten ceftibuten-avibactam piperacillin-tazobactam
<i>E. coli</i> NCTC 13353	ceftazidime-avibactam ceftibuten-avibactam ceftibuten-ledaborbactam
<i>K. pneumoniae</i> ATCC BAA-2814	ceftazidime-avibactam ceftibuten-avibactam ceftibuten-ledaborbactam meropenem-xeruborbactam
<i>K. pneumoniae</i> ATCC BAA-1705	ceftazidime-avibactam ceftibuten-avibactam ceftibuten-ledaborbactam
<i>K. pneumoniae</i> ATCC 700603	ceftibuten ceftibuten-avibactam
<i>P. aeruginosa</i> ATCC 27853	meropenem-xeruborbactam

CLSI M100-Ed33, 2023

# MORE MIC QC ADDITIONS/REVISIONS

tebipenem	<i>H. influenzae</i> ATCC 49766 <i>S. pneumoniae</i> ATCC 49619
-----------	--



Thank you for your attention.  
Have a better 2023.