

**UCLA**

Health System

**Antimicrobial  
Susceptibility  
Summary  
2023**

**Clinical Microbiology  
Department of Pathology & Laboratory Medicine**

# **Antimicrobial Susceptibility Summary**

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**UCLA Health System**

**2023**

The information contained in this booklet can also  
be found at:

<https://asp.mednet.ucla.edu/pages/>

Select “Clinical Microbiology”  
at the top of the homepage

# Preface

This booklet contains up-to-date information to assist the clinician in making decisions concerning antimicrobial therapy and testing.

These tables summarize susceptibility data obtained for organisms isolated in the UCLA Clinical Microbiology Laboratory in 2022.

In order to provide the most meaningful information, the laboratory is selective in reporting antimicrobial susceptibility results.

Reporting guidelines are based on:

1. Identity of the organism
2. Body site of culture
3. Overall antibiogram of the organism
4. Therapeutically relevant antimicrobials
5. Formulary status of the antimicrobial

Non-formulary drugs are not routinely reported and controlled formulary agents are reported only in the appropriate setting: e.g. amikacin and tobramycin if resistant to gentamicin. Results of all relevant drugs tested, including those not reported, are available upon request.

We thank:

Daniel Uslan, MD, Chief Infection Prevention  
Tara Vijayan, MD, Medical Director, Adult ASP  
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Allison Tsan, CLS, Sr. Specialist, Brentwood Annex  
Stephanie Horiuchi, CLS, Sr. Specialist, Brentwood Annex

# Guidelines for Interpretation of Minimal Inhibitory Concentrations (MICs)

MICs are interpreted as susceptible, susceptible dose dependent, intermediate, resistant, or non-susceptible according to Clinical and Laboratory Standards Institute (CLSI) M100, 33<sup>rd</sup> edition guidelines. When deciding whether the interpretation is meaningful, one should consider the antimicrobial pharmacokinetics, taking into account dosage and route of administration, the infecting organism and site of infection, and previous clinical experience.

For antimicrobials without interpretive criteria consultation with Infectious Diseases strongly advised.

For additional information, please call the antimicrobial testing laboratory, or Antimicrobial Stewardship hotline.

Clinical Microbiology  
UCLA Health System  
Department of Pathology and Laboratory Medicine  
171315

Frequently called numbers\*:

Antimicrobial Stewardship: <a href="mailto:antimicrobialstewardship@mednet.ucla.edu">antimicrobialstewardship@mednet.ucla.edu</a>
Antimicrobial Testing Laboratory: 310-794-2760
Drug Information Center: 310-267-8522
Infection Control SMH-UCLA: 424-259-4454
Infection Control RRUMC: 310-794-0187
Infectious Diseases Adult: 310-825-7225
Infectious Diseases Pediatric: 310-825-5235
RRMC and RNPH ID Pharmacist - Adult: 310-267-1423, page 99917
RRMC ID Pharmacist - Adult and Pediatric: 310-267-8510, page 92528
SMH ID Pharmacist - Adult: 310-267- 7567, page 91059
Microbiology Fellow on-call: page 90103

\* If calling within UCLA system, dial the last 5 digits of the phone number.

## **Resources at UCLA through the Antimicrobial Stewardship Program (ASP)**

The Antimicrobial Stewardship Program (ASP) has made resources available for the sole purpose of improving clinical outcomes of patients with infections. Questions and guidance on interpretation of culture reports (contaminant/pathogen), drug dosing, etc. are welcome. The ASP can be contacted numerous ways, depending on the urgency and clinical needs:

ASP Helpdesk/Consultation Email:

[antimicrobialstewardship@mednet.ucla.edu](mailto:antimicrobialstewardship@mednet.ucla.edu)

Website: <https://asp.mednet.ucla.edu/pages/>

Note that the website has a **guidebook**, with detailed information about specific clinical syndromes, interpretation of microbiology reports, and guidelines for treatment.

We encourage you to reach out to the program with questions. The program is staffed by:

- Christine Pham, PharmD, ID Pharmacist
- Ethan Smith, PharmD, ID Pharmacist
- Lynn Chan, PharmD, BCID, ID Pharmacist
- Meganne Kanatani, PharmD, ID Pharmacist
- Daniel Uslan, MD, Chief Infection Prevention
- Tara Vijayan, MD, Medical Director, Adult ASP
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- Omai Garner, PhD, Section Chief Clinical Microbiology
- Sukantha Chandrasekaran, PhD, D(ABMM), Associate Director, Clinical Microbiology

# Table of Contents

<b>Table</b> .....	<b>Page</b>
--------------------	-------------

## Adults

1	Adults (>21 y.o.) Most Common Gram-negative Bacteria – Non-Urine Isolates, % Susceptible.....	1
2	Adults (>21 y.o.) Gram-negative Bacteria – Non-Urine Isolates, % Susceptible.....	2
3	Adults (>21 y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible .....	3
4	Adults (>21 y.o.) Gram-positive Cocci, % Susceptible.....	4

## Adults/Peds

5	Miscellaneous Gram-negative Bacteria .....	6
6	Multiple Drug Resistant Gram-negative Bacteria – All sources, % Susceptible.....	7

## Peds

7	Pediatrics ( $\leq$ 21 y.o.) Gram-negative Bacteria – Non-Urine Isolates, % Susceptible.....	8
8	Pediatrics ( $\leq$ 21 y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible .....	9
9	Pediatrics ( $\leq$ 21 y.o.) Gram-positive Cocci, % Susceptible .....	10

## Yeasts

10	Yeasts, %S, %I, %SDD, %R.....	12
----	-------------------------------	----

## Emerging Resistance Concerns

11	Emerging Resistance Concerns.....	13
12	Resistance Trends .....	17
13	Carbapenem-resistant Enterobacterales (CRE) .....	20
14	Treatment Suggestions for Organisms for which Susceptibility Testing is Not Routinely Performed .....	21

# Table of Contents

<b>Table</b> .....	<b>Page</b>
--------------------	-------------

## **Misc.**

15	Blood: One Isolate per Patient .....	22
16	CSF: One Isolate per Patient .....	24
17	Mycobacteria, One Isolate per Patient per Source .....	25
18	Mycobacteria Antimicrobial Susceptibility Testing .....	26
19	California Mycobacterium tuberculosis % Resistant .....	27
20	Rapid Grower – Mycobacteria % Susceptible .....	28
21	CLSI Anaerobic Bacteria Cumulative Antibiogram, % Susceptible .....	29

## **Lab Info**

22	Antimicrobials (IV, PO) Formulary Status and Cost Reference .....	30
23	Indications for Performing Routine Antimicrobial Susceptibility Tests – Aerobic Bacteria .....	33
24	Antimicrobial Agents Routinely Reported – Aerobic Bacteria .....	35
25	CLSI M62 – Expected Antimicrobial Susceptibility Patterns of the Most Commonly Isolated Nocardia Data Derived from CLSI M62 .....	39
26	Susceptible MIC ( $\mu\text{g/ml}$ ) Breakpoints for Aerobic Gram-negative Bacilli .....	40
27	Susceptible MIC ( $\mu\text{g/ml}$ ) Breakpoints for Aerobic Gram-positive Cocci .....	41

## **Antimicrobial Stewardship Program**

28	Antimicrobial Stewardship .....	42
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# Glossary and Acronyms

—	Not routinely tested and/or not applicable
%R	Percent resistant
%S	Percent susceptible
Cipro R	Ciprofloxacin resistant
CP CRE	Carbapenemase producing carbapenem resistant Enterobacterales
CRE	Carbapenem Resistant Enterobacterales
I	Intermediate
ICU	Intensive care unit
IP	Inpatient ( <b>excludes</b> intensive care unit and Emergency Department)
MDR	Multi-drug resistant
Mero R	Meropenem resistant
MIC	Minimal inhibitory concentration µg/mL
MRSA	Methicillin resistant Staphylococcus aureus
MSSA	Methicillin susceptible Staphylococcus aureus
Non-CP CRE	Non-Carbapenemase producing carbapenem resistant Enterobacterales
OP	Outpatient ( <b>includes</b> Emergency Department collections)
Pip-Tazo R	Piperacillin tazobactam resistant
R	Resistant, can be resistant due to intrinsic resistance
S	Susceptible
SDD	Susceptible dose dependent
spp.	Species
UTIs	Urinary tract infections
V	Variable
VRE	Vancomycin-resistant Enterococcus



**Table 1. Adults (> 21 y.o.) Most Common Gram-negative Bacteria – Non-Urine Isolates, % Susceptible**

Organism	Location	No. Isolates	Penicillin				Cephalosporins				Carbapenems			Aminoglycosides			Fluoro-quinolone		Other
			Ampicillin	Amoxicillin-Clavulanic acid	Ampicillin - sulbactam	Piperacillin – tazobactam <sup>1</sup>	Cefazolin	Cefepime <sup>1</sup>	Ceftazidime	Ceftriaxone <sup>2</sup>	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Trimethoprim - sulfamethoxazole
<i>Enterobacter cloacae</i> complex <sup>3</sup>	OP	114	R	R	R	91	R	99	— <sup>4</sup>	— <sup>4</sup>	97	99	99	99	97	96	96	96	89
	IP	107	R	R	R	76	R	97	— <sup>4</sup>	— <sup>4</sup>	89	99	99	99	99	99	97	98	86
	ICU	58	R	R	R	62	R	93	— <sup>4</sup>	— <sup>4</sup>	72	93	98	98	95	95	88	91	88
<i>Escherichia coli</i>	OP	312	—	73	—	94	57	84	86	81	99	99	99	95	83	82	69	69	63
	IP	341	—	65	—	92	50	77	77	73	99	99	99	93	81	80	60	62	60
	ICU	139	—	57	—	82	37	69	64	58	96	99	99	87	84	79	52	56	51
<i>Klebsiella pneumoniae</i>	OP	164	R	83	—	88	80	83	84	82	96	98	98	98	90	85	77	84	76
	IP	227	R	83	—	80	79	83	83	81	96	97	97	97	91	89	74	82	75
	ICU	146	R	75	—	73	75	79	81	76	91	97	93	95	91	86	73	79	77
<i>Proteus mirabilis</i>	OP	136	—	91	—	98	6	92	97	85	99	— <sup>5</sup>	99	93	85	88	72	73	71
	IP	122	—	88	—	94	3	88	95	80	99	— <sup>5</sup>	99	83	78	79	61	62	62
	ICU	46	—	87	—	100	0	76	96	65	99	— <sup>5</sup>	99	96	76	83	46	46	57
<i>Pseudomonas aeruginosa</i>	OP	499	R	R	R	87	R	88	89	R	R	85	88	— <sup>6</sup>	— <sup>6</sup>	91	72	68	R
	IP	372	R	R	R	74	R	83	77	R	R	77	81	— <sup>6</sup>	— <sup>6</sup>	90	72	63	R
	ICU	149	R	R	R	53	R	70	61	R	R	51	53	— <sup>6</sup>	— <sup>6</sup>	89	64	52	R

<sup>1</sup> %S includes %SDD

<sup>2</sup> Cefotaxime and ceftriaxone have comparable activity against *Enterobacterales*.

<sup>3</sup> *Enterobacter cloacae* complex includes *E.cloacae*, *E.asburiae*, and *E.hormaecheii*.

<sup>4</sup> 3<sup>rd</sup> generation cephalosporins should not be used for serious infections.

<sup>5</sup> *Proteus* spp. may have elevated imipenem MIC by mechanisms other than production of carbapenemases.

<sup>6</sup> As of 2023, *Pseudomonas aeruginosa* breakpoints were revised, and tobramycin is now the only recommended aminoglycoside for systemic therapy. Amikacin is effective against *P. aeruginosa* only in urinary tract infections. Gentamicin is no longer recommended for *P. aeruginosa* infection at any site.

**Table 2. Adults (> 21 y.o.) Gram-negative Bacteria – Non-Urine Isolates, % Susceptible**

Organism	No. Isolates	Penicillin		Cephalosporins				Carbapenems			Aminoglycosides			Fluoroquinolone		Other
		Amoxicillin-Clavulanic acid	Piperacillin-tazobactam	Cefazolin	Cefepime <sup>1</sup>	Ceftazidime	Ceftriaxone <sup>2</sup>	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Trimethoprim sulfamethoxazole
<i>Citrobacter freundii</i> complex <sup>3</sup>	79	R	72	R	99	— <sup>4</sup>	— <sup>4</sup>	97	99	100	99	95	93	90	90	89
<i>Klebsiella (Enterobacter) aerogenes</i>	147	R	76	R	96	— <sup>4</sup>	— <sup>4</sup>	93	95	95	99	98	98	95	97	94
<i>Enterobacter cloacae</i> complex <sup>5</sup>	235	R	76	R	96	— <sup>4</sup>	— <sup>4</sup>	93	95	95	99	98	98	95	96	94
<i>Escherichia coli</i>	730	67	91	51	84	79	74	98	99	99	92	83	81	62	65	60
<i>Klebsiella oxytoca</i>	162	90	94	11	99	96	91	99	99	99	99	97	96	96	98	94
<i>Klebsiella pneumoniae</i>	452	81	80	65	86	83	79	95	97	96	97	91	87	75	80	76
<i>Morganella morganii</i>	54	R	99	R	94	— <sup>4</sup>	— <sup>4</sup>	99	— <sup>6</sup>	99	99	91	96	67	99	70
<i>Proteus mirabilis</i>	248	91	97	4	96	97	82	99	— <sup>6</sup>	99	90	83	86	67	68	68
<i>Serratia marcescens</i>	182	R	93	R	99	— <sup>4</sup>	— <sup>4</sup>	98	97	99	97	96	88	73	82	95
<i>Acinetobacter baumannii</i> complex <sup>7</sup>	76	—	45	R	58	55	—	R	59	58	70	65	67	59	62	59
<i>Pseudomonas aeruginosa</i>	870	R	70	R	84	81	R	R	79	82	— <sup>8</sup>	— <sup>8</sup>	95	71	64	R
<i>Stenotrophomonas maltophilia</i>	71	R	R	R	—	—	R	R	R	R	R	R	R	—	42 <sup>9</sup>	99
<i>Achromobacter</i> spp.	69	—	94	R	6	71	—	—	91	87	0	1	0	1	36	88

<sup>1</sup> %S includes %SDD

<sup>2</sup> Ceftriaxone and cefotaxime have comparable activity against *Enterobacterales*.

<sup>3</sup> *Citrobacter freundii* complex includes *C. freundii*, *C. youngae*, *C. braakii*, and *C. werkmanii*.

<sup>4</sup> 3<sup>rd</sup> generation cephalosporins should not be used for serious infections.

<sup>5</sup> *Enterobacter cloacae* complex includes *E. cloacae*, *E. asburiae*, and *E. hormaecheii*.

<sup>6</sup> *Proteus* spp. and *Morganella* spp. may have elevated imipenem MIC by mechanisms other than production of carbapenemases.

<sup>7</sup> *Acinetobacter baumannii* complex includes *A. baumannii*, *A. calcoaceticus*, *A. pittii*, and *A. nosocomialis*.

<sup>8</sup> As of 2023, *Pseudomonas aeruginosa* breakpoints were revised, and tobramycin is now the only recommended aminoglycoside for systemic therapy. Amikacin is effective against *P. aeruginosa* only in urinary tract infections. Gentamicin is no longer recommended for *P. aeruginosa* infection at any site.

<sup>9</sup> Levofloxacin should not be used alone for antimicrobial therapy.

**Table 3. Adults (> 21 y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible**

Organism	Location	No. Isolates	Penicillin		Cephalosporin			Carbapenem			Aminoglycoside			Fluoro-quinolone		Other	
			Ampicillin	Amoxicillin – Clavulanic acid	Oral Cephalosporin <sup>1</sup>	Cefepime <sup>2</sup>	Ceftriaxone <sup>3</sup>	Ertapenem	Imipenem	Meropenem	Gentamicin	Tobramycin	Amikacin	Ciprofloxacin	Levofloxacin	Nitrofurantoin	Trimethoprim – sulfamethoxazole
<i>Enterobacter cloacae complex</i>	OP	243	R	R	R	R	— <sup>4</sup>	92	98	98	97	97	—	88	88	43	87
	IP	26 <sup>5</sup>	R	R	R	92	— <sup>5</sup>	92	99	99	96	92	—	85	85	42	77
<i>Escherichia coli</i>	OP	9039	56	86	87	—	89	99	99	99	90	89	—	75	70	97	74
	IP	421	40	74	72	—	73	99	99	99	84	82	—	55	50	94	65
<i>Klebsiella pneumoniae</i>	OP	1534	R	R	88	—	89	99	99	99	94	93	—	85	82	26	84
	IP	164	R	R	70	—	72	96	98	97	88	82	—	66	62	23	66
<i>Proteus mirabilis</i>	OP	851	80	83	92	—	94	99	—	99	92	92	—	84	84	R	80
	IP	74	66	74	80	—	85	99	—	99	86	86	—	65	65	R	69
<i>Pseudomonas aeruginosa</i> <sup>6</sup>	OP	489	R	R	R	94	R	R	88	92	— <sup>7</sup>	97	91	82	76	R	R
	IP	98	R	R	R	83	R	R	80	81	— <sup>7</sup>	97	86	76	72	R	R

<sup>1</sup> Oral cephalosporins include cefpodoxime and cephalexin for treatment of uncomplicated urinary tract infections.

<sup>2</sup> %S includes %SDD

<sup>3</sup> Ceftriaxone and cefotaxime have comparable activity against *Enterobacterales*.

<sup>4</sup> 3<sup>rd</sup> generation cephalosporin should not be used for serious infections.

<sup>5</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>6</sup> Ceftazidime: OP 92%, IP 80%, Piperacillin-tazobactam: OP 91%, IP 78%.

<sup>7</sup> As of 2023, *Pseudomonas aeruginosa* breakpoints were revised, and tobramycin is now the only recommended aminoglycoside for systemic therapy. Amikacin is effective against *P. aeruginosa* only in urinary tract infections. Gentamicin is no longer recommended for *P. aeruginosa* infection at any site.

**Table 4. Adults (> 21 y.o.) Gram-positive Cocci, % Susceptible**

Organism	Location	No. Isolates	Penicillins			Other										
			Ampicillin	Oxacillin	Penicillin	High Level Gentamicin <sup>1</sup>	Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Rifampin <sup>2</sup>	Trimethoprim sulfamethoxazole	Vancomycin	Ceftaroline
<i>Staphylococcus aureus</i>	All	2204	—	73 <sup>3</sup>	25	—	73	70	99	99	53	99	99	99	99	99
Oxacillin-resistant <i>S. aureus</i> (MRSA)	OP	388	—	R <sup>3</sup>	R <sup>3</sup>	—	27	63	99	98	18	99	98	97	99	99
	IP	168	—	R <sup>3</sup>	R <sup>3</sup>	—	18	52	99	97	14	99	97	98	99	99
	ICU	75	—	R <sup>3</sup>	R <sup>3</sup>	—	20	52	99	95	17	99	99	99	99	99
Oxacillin-susceptible <i>S. aureus</i> (MSSA)	OP	1139	—	100	36	—	89	74	99	99	67	99	99	99	99	99
	IP	376	—	100	31	—	90	73	99	98	67	99	99	99	99	99
	ICU	157	—	100	29	—	91	74	99	99	66	99	99	99	99	99
<i>Staphylococcus epidermidis</i>	All	499	—	44	11	—	62	61	99	88	39	99	96	60	99	—
<i>Staphylococcus haemolyticus</i>	All	60	—	66	48	—	60	57	99	92	28	99	95	80	99	—
<i>Staphylococcus lugdunensis</i> <sup>4</sup>	All	267	—	94	48	—	97	85	99	99	82	99	99	99	99	—
<i>Staphylococcus pseudintermedius/ intermedius</i>	All	54	—	80	17	—	67	50	99	72	48	99	99	63	99	—
Coagulase negative <i>Staphylococcus</i> <sup>5,6</sup>	All	115	—	75	35	—	81	80	97	98	54	99	99	88	99	—
<i>Enterococcus</i> spp. <sup>7 8</sup>	All	48	90	—	—	— <sup>9</sup>	63	R	79	65	R	100	54	R	78	R
<i>Enterococcus faecalis</i> <sup>7</sup>	All	664	99	—	—	81 <sup>10</sup>	66	R	92	41	R	99	25	R	98	R
<i>Enterococcus faecium</i> <sup>7</sup>	All	193	12	—	—	85 <sup>10</sup>	8	R	84 <sup>11</sup>	59	R	99	6	R	37	R

<sup>1</sup> High level gentamicin 500µg/mL.

<sup>2</sup> Rifampin should not be used as monotherapy.

<sup>3</sup> *Staphylococcus* resistant to oxacillin are resistant to cefazolin, cephalexin, ceftriaxone and all other beta-lactams except ceftaroline.

<sup>4</sup> *S. lugdunensis* is best treated with a Beta-lactam agent.

<sup>5</sup> *S. saprophyticus* urinary tract infections respond to antibiotic concentrations achieved in urine with agents commonly used to treat acute uncomplicated UTIs.

<sup>6</sup> Excluding *S. epidermidis*, *S. lugdunensis* and *S. pseudintermedius*.

<sup>7</sup> Serious Enterococcal infections need combination therapy of ampicillin plus ceftriaxone or an aminoglycoside.

<sup>8</sup> *Enterococcus* spp. excludes *E. faecalis* and *E. faecium*.

<sup>9</sup> Insufficient data to calculate % susceptible.

<sup>10</sup> % susceptible calculated with isolated tested from sterile body sites. *E. faecalis* n=71 and *E. faecium* n=39.

<sup>11</sup> % susceptible includes susceptible dose dependent.

**Table 4. Adults (> 21 y.o.) Gram-positive Cocci, % Susceptible (cont.)**

Organism	No. Isolates	Penicillins		Cephalosporins		Clindamycin	Other					
		Amoxicillin	Penicillin	Cefotaxime	Ceftriaxone		Doxycycline	Erythromycin	Levofloxacin	Trimethoprim – sulfamethoxazole	Tetracycline	Vancomycin
<i>Streptococcus pneumoniae</i>	18 <sup>1</sup>	94	—	—	—	78	78	61	100	72	—	100
Meningitis <sup>2</sup>		—	56	89	84	—	—	—	—	—	—	—
Non-meningitis <sup>3</sup>		—	94	99	99	—	—	—	—	—	—	—
Viridans group <i>Streptococcus spp.</i> <sup>4</sup>	181	—	73 <sup>5</sup>	98	97	—	—	—	—	—	—	100
<i>Streptococcus anginosus</i>	71	—	97	99	99	—	—	—	—	—	—	100
<i>Streptococcus agalactiae</i> (Group B streptococci)	68	—	100	—	—	49	—	—	—	—	—	100
<i>Streptococcus pyogenes</i> (Group A streptococci)	25 <sup>1</sup>	—	100	—	—	80	—	72	—	—	60	100

<sup>1</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>2</sup> % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients with meningitis.

<sup>3</sup> % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients without meningitis.

<sup>4</sup> Excluding *Streptococcus anginosus* group.

<sup>5</sup> Resistant (R) includes 24% Intermediate (MIC 0.25-2 µg/ml) and 2% High-level (MIC >2 µg/ml) resistance.

**Table 5. Miscellaneous Gram-negative Bacteria**

Organism	No. Isolates	% beta-lactamase positive <sup>1</sup>
<i>Haemophilus influenzae</i>	73 (pts. >21 y.o) 24 (pts. ≤21 y.o.)	37 25
<i>Moraxella catarrhalis</i>	30 (pts. >21 y.o) 8 (pts. ≤21 y.o.)	100 87
<i>Neisseria gonorrhoeae</i>	<p>The current therapy recommendation is ceftriaxone. Culture and susceptibility testing should be performed in cases of treatment failure. See <a href="http://www.cdc.gov/std/Gonorrhea/treatment.htm">http://www.cdc.gov/std/Gonorrhea/treatment.htm</a></p> <p>PER STD 2021 treatment guidelines, the recommended treatment for gonorrhea is ceftriaxone 500 mg IM x 1 for patients &lt;150 kg, 1g for patients ≥ 150 kg.</p> <p>Doxycycline 100mg twice daily for 7 days is recommended if there is suspicion or confirmed Chlamydia co-infection</p>	
<i>Neisseria meningitidis</i>	<p>The current therapy recommendation is ceftriaxone for treating meningococcal infections. Penicillin may be considered after susceptibilities return and MIC is ≤0.12 µg/mL (Antimicrob Agents Chemother 56:2268, 2012). Reports have noted some isolates with resistance to fluoroquinolones, agents often used for prophylaxis (MMWR. 2008. 57:173-175).</p> <p><b>Sanford guide 2022</b> Recommended: Ceftriaxone Alternative: Meropenem</p>	

<sup>1</sup> Resistant to ampicillin, amoxicillin, and penicillin.

**Table 6. Multiple Drug Resistant Gram-negative Bacteria – All sources  
% Susceptible**

Organism	Amikacin		Aztreonam		Ceftazidime-Avibactam <sup>1</sup>		Ceftolozane-Tazobactam <sup>1</sup>		Tigecycline <sup>2</sup>		Meropenem-Vaborbactam <sup>1</sup>		Eravacycline <sup>2,3</sup>		Omadacycline <sup>2,4</sup>	
	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible
<b>Carbapenem Resistant Enterobacterales (CRE)<sup>5</sup></b>	299	96	94	13	299	95	296	67	142	89	93	85	132	73	132	73

Organism	Number of Isolates	Amikacin	Gentamicin	Ciprofloxacin	Piperacillin-Tazobactam	Cefepime	Ceftazidime	Ceftazidime-Avibactam <sup>1,2</sup>	Ceftolozane-Tazobactam <sup>1,2</sup>	Colistin % Intermediate <sup>1,6</sup>	Minocycline	Trimethoprim-sulfamethoxazole
<i>Pseudomonas aeruginosa</i> , Imipenem or Meropenem resistant	202	65 <sup>7</sup>	—	40	25	52	46	77	84	100 <sup>9</sup>	0	R
<i>Pseudomonas aeruginosa</i> , Imipenem and Meropenem resistant	140	60 <sup>7</sup>	—	33	6	38	31	68	78	100 <sup>9</sup>	0	R
<i>Acinetobacter baumannii</i> complex <sup>8</sup> , Meropenem resistant	27 <sup>9</sup>	30	22	11	0	0	15	—	—	100 <sup>9</sup>	62	22

<sup>1</sup> Restricted formulary. ID consult required.

<sup>2</sup> Interpretations are based on FDA breakpoints. There are no current CLSI breakpoints available for these drugs. Please refer to the FDA website at: <https://www.fda.gov/drugs/development-resources/antibacterial-susceptibility-test-interpretive-criteria>.

<sup>3</sup> FDA guidelines indicated that clinical efficacy was shown for *Citrobacter freundii*, *Enterobacter cloacae*, *Escherichia coli*, *Klebsiella oxytoca* & *Klebsiella pneumoniae*.

<sup>4</sup> FDA breakpoint for Omadacycline applies to *Klebsiella pneumoniae* only and indicated for Community Acquired Bacterial Pneumonia (CABP) and Acute Bacterial Skin/Skin Structure Infections (ABSSI).

<sup>5</sup> CRE: Enterobacterales resistant to one or more carbapenem i.e. Ertapenem, Imipenem or Meropenem

<sup>6</sup> Routine colistin testing was discontinued on December 2020.

<sup>7</sup> Amikacin for *Pseudomonas aeruginosa* is for Urine isolates only.

<sup>8</sup> *Acinetobacter baumannii* complex includes *A. baumannii*, *A. calcoaceticus*, *A. pittii* and *A. nosocomialis*.

<sup>9</sup> Calculated from fewer than the standard recommendation of 30 isolates.

**Table 7. Pediatrics ( $\leq 21$  y.o.) Gram-negative Bacteria – Non-Urine Isolates, % Susceptible**

Organism	No. Isolates	Penicillins				Cephalosporins				Carbapenems			Aminoglycosides			Fluoroquinolone	Other
		Ampicillin <sup>1</sup>	Amoxicillin-Clavulanic acid	Ampicillin-sulbactam <sup>1</sup>	Piperacillin-tazobactam	Cefazolin	Cefepime	Ceftazidime	Ceftriaxone <sup>2</sup>	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin <sup>3</sup>	Trimethoprim – sulfamethoxazole
<i>Enterobacter cloacae</i> complex <sup>4</sup>	38	R	R	R	82	R	89	— <sup>5</sup>	— <sup>5</sup>	97	99	99	99	99	99	94	94
<i>Escherichia coli</i>	62	—	66	—	87	71	81	82	76	98	98	98	92	84	83	69	68
<i>Klebsiella pneumoniae</i>	44	R	93	—	95	91	91	93	89	99	99	99	99	95	95	89	84
<i>Serratia marcescens</i>	25 <sup>6</sup>	R	R	R	84	R	96	— <sup>5</sup>	— <sup>5</sup>	96	99	99	96	96	92	88	99
<i>Pseudomonas aeruginosa</i>	80	R	R	R	64	R	84	81	R	R	84	90	— <sup>7</sup>	— <sup>7</sup>	94	81	R

<sup>1</sup> Ampicillin and Ampicillin-sulbactam testing were discontinued on July 26, 2016.

<sup>2</sup> Ceftriaxone and cefotaxime have comparable activity against *Enterobacteriaceae*.

<sup>3</sup> Ciprofloxacin is associated with arthropathy and histological changes in weight-bearing joints of juvenile animals and should only be used when no safe and effective alternatives exist.

<sup>4</sup> *Enterobacter cloacae* complex includes *E. cloacae*, *E. asburiae*, and *E. hormaecheii*.

<sup>5</sup> 3<sup>rd</sup> generation cephalosporins should not be used for serious infections.

<sup>6</sup> Calculated from fewer than the standard recommendation of 30 isolates

<sup>7</sup> As of 2023, *Pseudomonas aeruginosa* breakpoints were revised, and tobramycin is now the only recommended aminoglycoside for systemic therapy. Amikacin is effective against *P. aeruginosa* only in urinary tract infections. Gentamicin is no longer recommended for *P. aeruginosa* infection at any site.



**Table 8. Pediatrics ( $\leq 21$  y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible**

Organism	No. Isolates	Penicillins		Cephalosporins			Carbapenems			Amino-glycosides			Fluoroquinolone	Other		
		Ampicillin	Amoxicillin - Clavulanic acid	Oral Cephalosporins <sup>1</sup>	Cefepime	Ceftazidime	Ceftriaxone <sup>2</sup>	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin <sup>3</sup>	Trimethoprim – sulfamethoxazole	Nitrofurantoin
<i>Enterobacter cloacae</i> complex <sup>4</sup>	18 <sup>5</sup>	R	R	R	94	—	—	94	94	94	—	94	—	83	83	22
<i>Escherichia coli</i>	755	58	86	91	—	—	93	99	99	99	—	91	90	82	74	99
<i>Klebsiella pneumoniae</i>	65	R	95	95	—	—	95	99	99	99	—	97	96	91	86	18
<i>Proteus mirabilis</i>	64	91	89	97	—	—	97	99	— <sup>6</sup>	99	—	98	99	91	88	R
<i>Pseudomonas aeruginosa</i>	26 <sup>5</sup>	R	R	R	92	85	R	R	88	88	92	— <sup>7</sup>	99	85	R	R

<sup>1</sup> Oral Cephalosporins include Cefpodoxime and Cephalexin for treatment of uncomplicated urinary tract infections.

<sup>2</sup> Ceftriaxone and Cefotaxime have comparable activity against *Enterobacterales*.

<sup>3</sup> Ciprofloxacin is associated with arthropathy and histological changes in weight-bearing joints of juvenile animals and should only be used when no safe and effective alternatives exist.

<sup>4</sup> *Enterobacter cloacae* complex includes *E. cloacae*, *E. asburiae*, and *E. hormaecheii*.

<sup>5</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>6</sup> *Proteus* spp. may have elevated imipenem MIC by mechanisms other than production of carbapenemases.

<sup>7</sup> As of 2023, *Pseudomonas aeruginosa* breakpoints were revised, and tobramycin is now the only recommended aminoglycoside for systemic therapy. Amikacin is effective against *P. aeruginosa* only in urinary tract infections. Gentamicin is no longer recommended for *P. aeruginosa* infection at any site.

**Table 9. Pediatrics (≤ 21 y.o.) Gram-positive Cocci, % Susceptible**

Organism	Location	No. Isolates	Penicillins			Cephalosporins		Others											
			Ampicillin	Oxacillin	Penicillin	Ceftriaxone	Cefotaxime	High Level Gentamicin <sup>1</sup>	Ciprofloxacin <sup>2</sup>	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Quinupristin-dalfopristin	Rifampin <sup>3</sup>	Trimethoprim-sulfamethoxazole	Vancomycin	Ceftaroline
<i>Staphylococcus aureus</i> (All)	OP	284	—	86	28	—	—	—	85	76	99	99	63	99	99	99	99	99	99
	IP	91	—	80	24	—	—	—	80	70	99	99	55	99	99	99	99	99	99
Oxacillin-resistant <i>S. aureus</i> (MRSA) <sup>3</sup>	OP	41	—	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	—	37	78	99	99	24	99	99	99	99	99	99
	IP	18 <sup>5</sup>	—	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	R <sup>4</sup>	—	28	61	99	99	22	99	99	99	99	99	99
Oxacillin-susceptible <i>S. aureus</i> (MSSA)	OP	244	—	100	32	—	—	—	93	76	99	99	68	99	99	99	99	99	99
	IP	75	—	100	29	—	—	—	93	73	99	99	64	99	99	99	99	99	99
Coagulase negative <i>Staphylococcus</i> <sup>6</sup>	OP	16 <sup>5</sup>	—	75	44	—	—	—	99	88	99	99	63	99	94	88	99	—	—
	IP	17 <sup>5</sup>	—	65	41	—	—	—	94	65	99	94	35	99	99	99	99	—	—
<i>Staphylococcus epidermidis</i>	All	70	—	34	7	—	—	—	71	40	99	83	21	99	93	63	99	70	—
<i>Staphylococcus lugdunensis</i>	All	22 <sup>5</sup>	—	82	48	—	—	—	99	77	99	99	73	99	99	99	99	82	—
<i>Enterococcus</i> spp. <sup>7</sup>	All <sup>8</sup>	5 <sup>5</sup>	99	—	—	R	R	99	80	R	40	80	R	99	20	R	99	99	—
<i>Enterococcus faecalis</i>	All	55	99	—	—	R	R	78	67	R	98	31	R	98	24	R	99	99	—
<i>Enterococcus faecium</i>	All	6 <sup>5</sup>	0	—	—	R	R	99	0	R	83	83	R	99	17	R	33	0	—

<sup>1</sup> High level Gentamicin 500 µg/ml.

<sup>2</sup> Ciprofloxacin is associated with arthropathy and histological changes in weight bearing joints of juvenile animals and should only be used when no safe and effective alternatives exist.

<sup>3</sup> Rifampin should not be used as monotherapy.

<sup>4</sup> *Staphylococcus* resistant to oxacillin are resistant to cefazolin, cephalexin, ceftriaxone and all other beta-lactams except ceftaroline.

<sup>5</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>6</sup> Excludes *S. epidermidis* and *S. lugdunensis*.

<sup>7</sup> Excludes *E. faecalis* and *E. faecium*.

<sup>8</sup> Includes isolates tested from all body sites.

**Table 9. Pediatrics ( $\leq 21$  y.o.) Gram-positive Cocci, % Susceptible (cont.)**

Organism	No. Isolates	Penicillins		Cephalosporins		Other				
		Amoxicillin	Penicillin	Cefotaxime	Ceftriaxone	Clindamycin	Doxycycline	Erythromycin	Trimethoprim – sulfamethoxazole	Vancomycin
<i>Viridans group Streptococcus</i>	14 <sup>1</sup>	—	43	79	79	—	—	—	—	100
<i>Streptococcus anginosus</i>	8 <sup>1</sup>	—	100	100	100	—	—	—	—	100
<i>Streptococcus pneumoniae</i>	6 <sup>1</sup>	100	—	—	—	100	100	100	50	100
Meningitis <sup>2</sup>		—	67	99	99	—	—	—	—	—
Non-meningitis <sup>3</sup>		—	99	99	99	—	—	—	—	—

<sup>1</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>2</sup> % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients with meningitis.

<sup>3</sup> % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients without meningitis.

**Table 10. Yeasts, %S, %I, %SDD, %R, 2021-2022**

- Most yeast infections can be treated empirically. Antifungal testing of yeasts may be warranted for the following:
  - Oropharyngeal or vaginal infections due to *Candida* spp. in patients who appear to be failing therapy.
  - Management of invasive *Candida* spp. infections when utility of an azole agent is uncertain (e.g., *Candida* spp. other than *C. albicans*), per IDSA guidelines for candidiasis: CID 2016:62, E1-E50. Clinical Practice Guidelines for the Management of Candidiasis.
- Isolation of *Candida* in respiratory specimens of immunocompetent patients should be interpreted as airway colonization.

Organism	No. of Isolates	Percent Susceptible, Susceptible Dose Dependent, Intermediate, Resistant at Breakpoints <sup>1, 2</sup>															
		MIC µg/mL	Fluconazole <sup>3</sup>			Voriconazole <sup>3</sup>			Caspofungin <sup>3</sup>			Micafungin <sup>3</sup>			Anidulafungin <sup>3</sup>		
			S	SDD	R	S	I	R	S	I	R	S	I	R	S	I	R
<i>Candida albicans</i>	356	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	
		%	87	7	6	94	4	2	99	0	0	99	0	0	99	0	0
<i>Candida glabrata</i>	168	—	≤ 32	≥ 64	— <sup>4</sup>	— <sup>4</sup>	— <sup>4</sup>	≤ 0.12	0.25	≥ 0.5	≤ 0.06	0.12	≥ 0.25	≤ 0.12	0.25	≥ 0.5	
		%	—	90	10	— <sup>4</sup>	— <sup>4</sup>	— <sup>4</sup>	98	1	1	97	0	3	98	0	2
<i>Candida parapsilosis</i>	85	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 2	4	≥ 8	≤ 2	4	≥ 8	≤ 2	4	≥ 8	
		%	86	4	10	91	2	7	99	0	0	99	0	0	85	15	0
<i>Candida tropicalis</i>	39	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	
		%	90	4	6	88	8	4	98	0	2	99	0	0	99	0	0
<i>Candida krusei</i>	29 <sup>5</sup>	—	—	—	≤ 0.5	1	≥ 2	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	
		%	R	R	R	95	0	5	95	5	0	99	0	0	99	0	0
<i>Candida guilliermondii</i>	7 <sup>5</sup>	—	—	—	—	—	—	≤ 2	4	≥ 8	≤ 2	4	≥ 8	≤ 2	4	≥ 8	
		%	—	—	—	—	—	—	99	0	0	99	0	0	88	12	0

<sup>1</sup> CLSI. Reference Method for Broth Dilution Antifungal Susceptibility Testing of Yeast. 4<sup>th</sup> ed. CLSI Standard M27. Wayne, PA.: Clinical and Laboratory Standards Institute; 2017

<sup>2</sup> CLSI. Performance Standards for Antifungal Susceptibility Testing of Yeasts. 2<sup>nd</sup> ed. CLSI Standard M27. Wayne, PA.: Clinical and Laboratory Standards Institute; 2017

<sup>3</sup> Not all isolates were tested against all four antifungal agents.

<sup>4</sup> For *C. glabrata* and voriconazole, current data are insufficient to demonstrate correlation between *in vitro* susceptibility testing and clinical outcome.

<sup>5</sup> Calculated from fewer than the standard recommendation of 30 isolates.

## Table 11. Emerging Resistance Concerns

When unusual antimicrobial resistance (R) is observed, an Infectious Disease (ID) consult is strongly suggested to optimize therapy and prevent nosocomial transmission.

Organism	Resistant to:	Percent Resistant:	Therapeutic Options	Comments
<i>Staphylococcus aureus</i>	Oxacillin (MRSA)	Adults (>21 y.o.) Inpatients (n=729) <sup>1</sup> 30% Outpatients (n=1515) <sup>1</sup> 26%  Pediatrics (≤21 y.o.) Inpatients (n=91) <sup>1</sup> 20% Outpatients (n=284) <sup>1</sup> 14%	vancomycin ceftaroline daptomycin	MRSA are clinically resistant to all β-lactams, β-lactam / β-lactamase inhibitor combinations and carbapenems, excluding ceftaroline. <sup>1</sup> MRSA are also typically resistant to fluoroquinolones
<i>Streptococcus pneumoniae</i> (non-meningitis)	Penicillin (MIC > 2 μg/ml)	All isolates (n=24) Penicillin MIC >2 μg/ml 4%	ceftriaxone or cefotaxime or vancomycin	If susceptible (MIC ≤2.0 μg/ml), high dose penicillin has been shown to be effective for infections other than meningitis. <sup>2</sup>
<i>Streptococcus pneumoniae</i> (non-meningitis)	Cefotaxime, Ceftriaxone (Penicillin resistant always)	All isolates (n=19)  Cefotaxime and ceftriaxone Low level R (n=1) 0% High level R (n=1) 0%	vancomycin levofloxacin	If low-level resistance (MIC=2.0 μg/ml), high dose cefotaxime or ceftriaxone may be effective for infections other than meningitis. <sup>2</sup>

<sup>1</sup> Isolates from all sources.

<sup>2</sup> The Sanford Guide to Antimicrobial Therapy. (2020). Sperryville, VA: Antimicrobial Therapy, Inc.

**Table 11. Emerging Resistance Concerns (cont.)**

When unusual antimicrobial resistance (R) is observed, an Infectious Disease (ID) consult is strongly suggested to optimize therapy and prevent nosocomial transmission.

Organism	Resistant to:	Percent Resistant:	Therapeutic Options	Comments
Viridans group <i>Streptococcus</i> (excludes <i>S.anginosus</i> group <sup>1</sup> )	penicillin	Blood isolates (n = 27) low level R 8% high level R 0%	vancomycin or penicillin + aminoglycoside	Level of penicillin resistance is particularly useful in guiding therapy for endocarditis. <sup>2</sup> For low level resistance, MICs are 0.25–2.0 µg/ml; for high level, MICs are >2.0 µg/ml. <sup>3</sup>
<i>Enterococcus</i> spp.	vancomycin (VRE)	Blood isolates <i>E. faecium</i> (n = 72) 69% <i>E. faecalis</i> (n = 93) 4%	Check in vitro susceptibility results and contact Infectious Diseases.	Vancomycin-resistant <i>Enterococcus</i> (VRE) are often resistant to many potentially useful agents. Therapeutic management must be determined on a case-by- case basis.
	High level gentamicin 500 µg/mL	Blood isolates <i>E. faecium</i> (n = 72) 14% <i>E. faecalis</i> (n = 93) 12%	Check in vitro susceptibility results and contact Infectious Diseases.	Both aminoglycoside and cell wall active agent (ampicillin, penicillin, or vancomycin) must be susceptible for synergistic interaction.

<sup>1</sup> *Streptococcus anginosus*, *Streptococcus intermedius*, and *Streptococcus constellatus*

<sup>2</sup> The Sanford Guide to Antimicrobial Therapy. (2020). Sperryville, VA: Antimicrobial Therapy, Inc.

<sup>3</sup> Baddour, L. M., et al. (2015). Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications: A Scientific Statement for Healthcare Professionals From the American Heart Association. *Circulation*, 132(15), 1435–1486.

**Table 11. Emerging Resistance Concerns (cont.)**

Organism	Resistant to:	Percent Resistant:	Therapeutic Options	Comments
<i>Klebsiella</i> spp. <i>E. coli</i>	ceftriaxone or other 3rd generation cephalosporin	Blood isolates: <i>Klebsiella</i> spp.(n = 157) 21% <i>E. coli</i> (n = 314) 28%	ertapenem ciprofloxacin	In vitro resistance to 3rd generation cephalosporins suggests the strain is producing extended-spectrum $\beta$ -lactamases (ESBL), or AmpC
<i>K. pneumoniae</i> and other <i>Enterobacterales</i>	carbapenem	All isolates (n = 17680): 2% Blood isolates (n=625): 4%	Check in vitro susceptibility results and contact Infectious Diseases.	Decreased susceptibility to carbapenems is increasing primarily among ICU patients' isolates. These isolates may be resistant to all available antimicrobial agents.
<i>Citrobacter freundii</i> complex <i>Enterobacter cloacae</i> complex <i>Klebsiella aerogenes</i>	3rd generation cephalosporins (e.g. ceftriaxone)	See comments	cefepime aminoglycoside ciprofloxacin ertapenem meropenem trimeth-sulfa	Organisms listed typically produce inducible $\beta$ -lactamases. Isolates that appear susceptible to 3rd generation cephalosporins may develop resistance during therapy. <sup>1</sup>
<i>Pseudomonas aeruginosa</i>	cefepime and/or piperacillin-tazobactam	All isolates: (n=1510) 18%	Check in vitro susceptibility results and contact Infectious Diseases.	Therapeutic management must be determined on a case by case basis.
<i>Acinetobacter baumannii</i> complex	amikacin, cefepime, ceftazidime, ciprofloxacin, meropenem, piperacillin-tazobactam, and trimeth-sulfa	All isolates: (n=97) 19%	Check in vitro susceptibility results and contact Infectious Diseases.	Therapeutic management must be determined on a case by case basis.

<sup>1</sup> Tamma, P., Aitken, S., Bonomo, R., Mathers, A., van Duin, D., & Clancy, C. (2021). IDSA guidance on the treatment of antimicrobial-resistant gram-negative infections: version 2.0. Arlington, VA: IDSA

## Table 11. Emerging Resistance Concerns (cont.)

When specific antimicrobial resistance (R) is detected, an Infectious Disease (ID) consult is strongly suggested.

Organism	If Resistant to:	Therapeutic Options	Comments
<i>Candida krusei</i>	casprofungin	voriconazole <sup>1</sup> amphotericin <sup>2</sup>	Typically susceptible to casprofungin. Breakthrough infections have been reported. <sup>3</sup>
	voriconazole	casprofungin <sup>4</sup> amphotericin <sup>2, 5</sup>	Intrinsically resistant to fluconazole <sup>6, 7</sup> Typically susceptible to voriconazole <sup>6, 7</sup>
<i>Candida glabrata</i>	casprofungin	fluconazole <sup>8</sup> voriconazole <sup>1</sup> amphotericin <sup>2, 5</sup>	Caspofungin resistance may be emerging. <sup>6</sup>
	fluconazole	voriconazole <sup>1</sup> casprofungin <sup>4</sup> amphotericin <sup>2, 5</sup>	Typically resistant to fluconazole. <sup>6, 7</sup>
<i>Candida albicans</i>	casprofungin	fluconazole <sup>8</sup> amphotericin <sup>2, 5</sup>	Typically susceptible to casprofungin. <sup>6, 7</sup>
	fluconazole	casprofungin <sup>4</sup> amphotericin <sup>2, 5</sup>	Typically susceptible to fluconazole but resistance can develop during therapy. <sup>6, 7</sup>
<i>Candida auris</i>	Often resistant to azoles, amphotericin and some are echinocandin resistant	Infectious Disease consult is strongly suggested	<i>Candida auris</i> is an emerging multi-drug resistant organism, able to cause wide range of infections.

For additional resistance data, see Tables 5-13.

These are therapeutic options in adults. For therapeutic options in pediatric patients, please contact the Antimicrobial Stewardship.

<sup>1</sup> Voriconazole has poor penetration in urine.

<sup>2</sup> Amphotericin has poor penetration in urine.

<sup>3</sup> Tavernier, E., et al. Development of echinocandin resistance in *Candida krusei* isolates following exposure to micafungin and casprofungin in a BM transplant unit. *Bone Marrow Transplant* 50, 158–160 (2015)

<sup>4</sup> Casprofungin may not reach therapeutic concentration in the CSF, vitreous fluid or urine.

<sup>5</sup> Among patients without baseline renal dysfunction and suspected azole- and echinocandin-resistant *Candida* infections, liposomal amphotericin B is recommended. Infectious Disease consult is highly recommended.

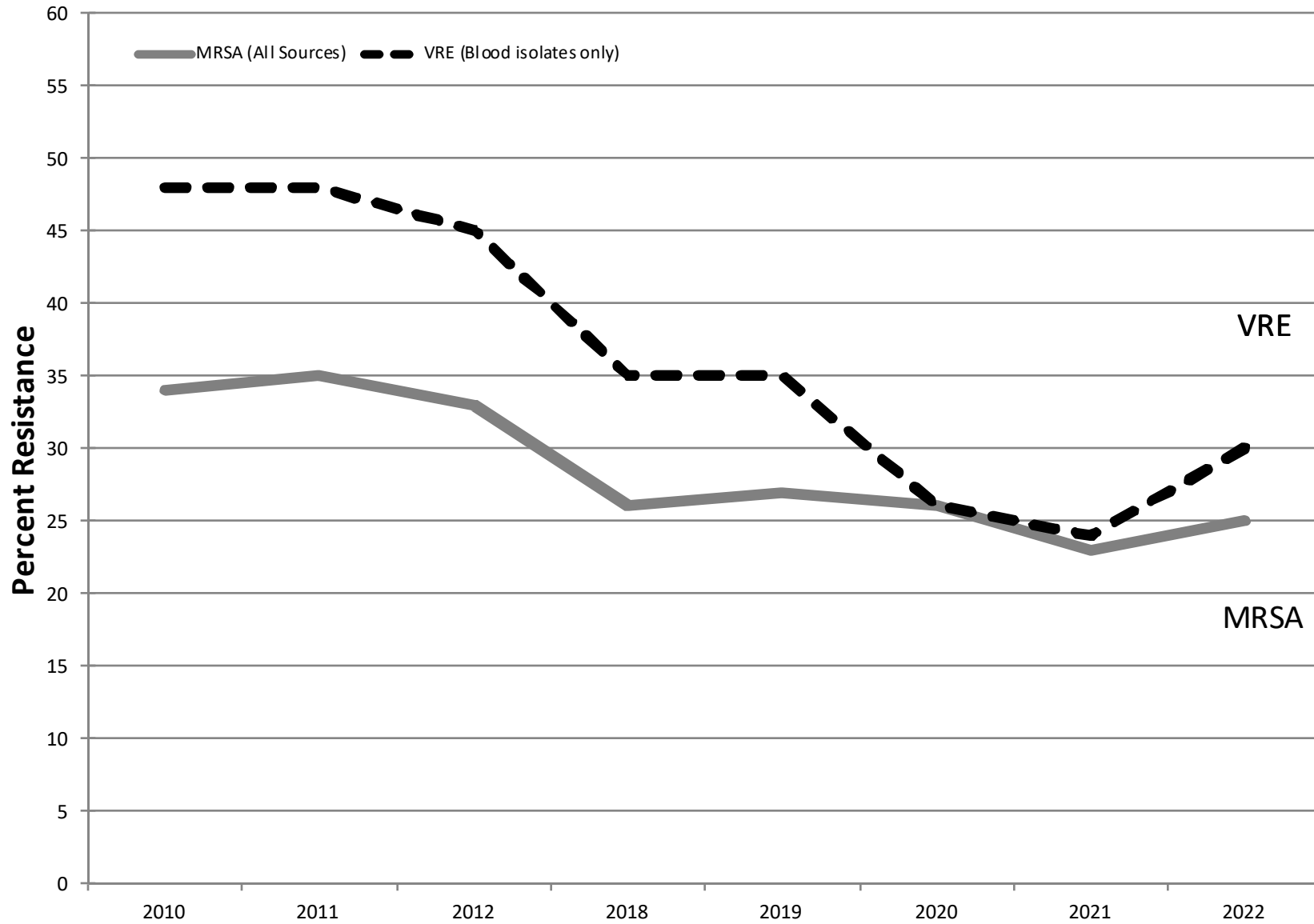
<sup>6</sup> Pappas, P. G., et al. (2016). Clinical Practice Guideline for the Management of Candidiasis: 2016 Update by the Infectious Diseases Society of America. *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America*, 62(4), e1–e50.

<sup>7</sup> Treatment Guidelines from the Med. Letter-Antifungal Drugs. 2012;10(120);61-68

<sup>8</sup> For initial treatment with fluconazole, careful consideration should be given, especially in critically ill patients or those with prior azole exposure or prophylaxis. Infectious Disease consult is highly recommended.



**Table 12. Resistance Trends: 1990-2022**

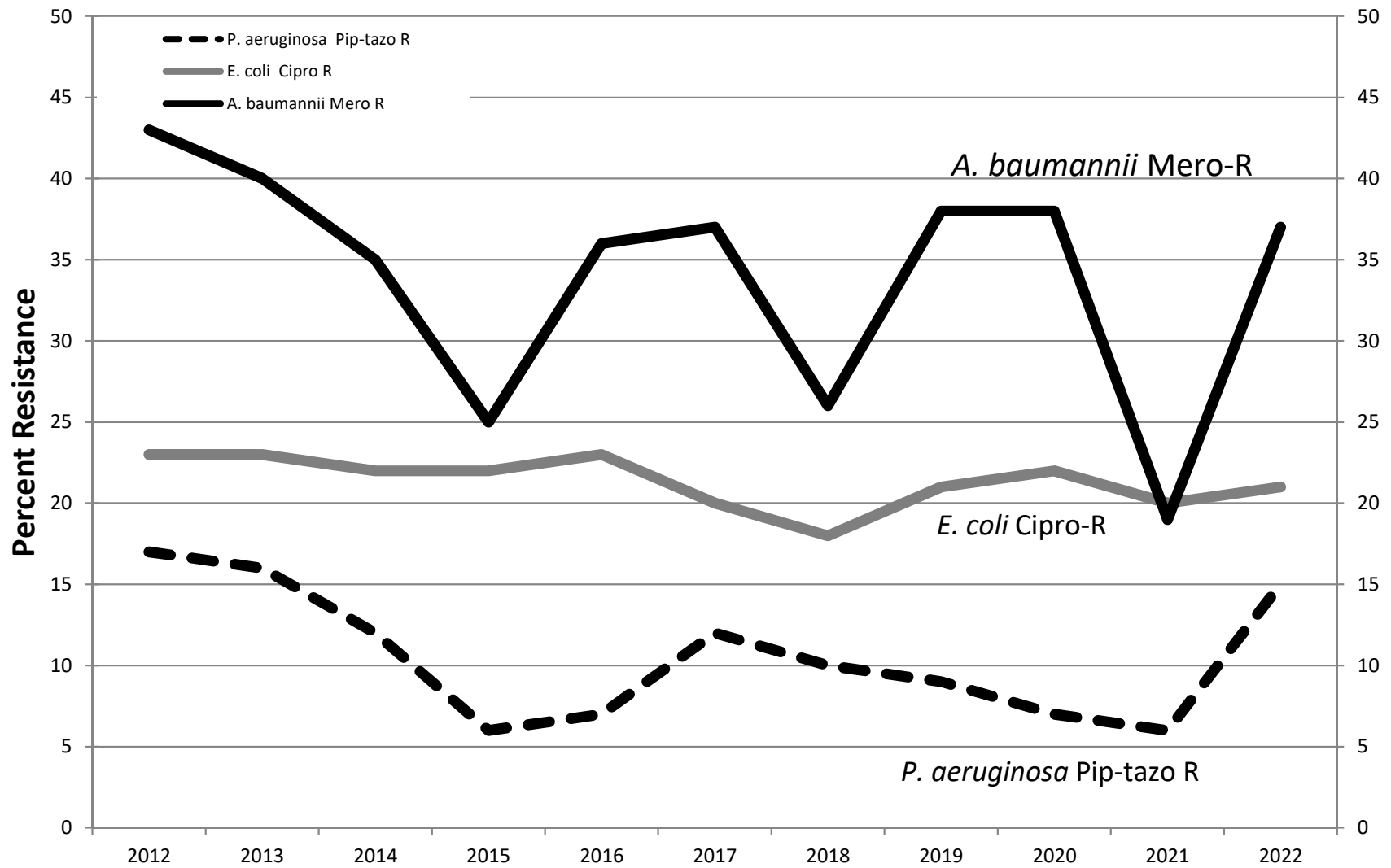


NOTE:

2010-2015: Derived from RRH data

2016-2022: Combined data from RRH and SMH

**Table 12. Resistance Trends: 1990-2022**  
(cont.)



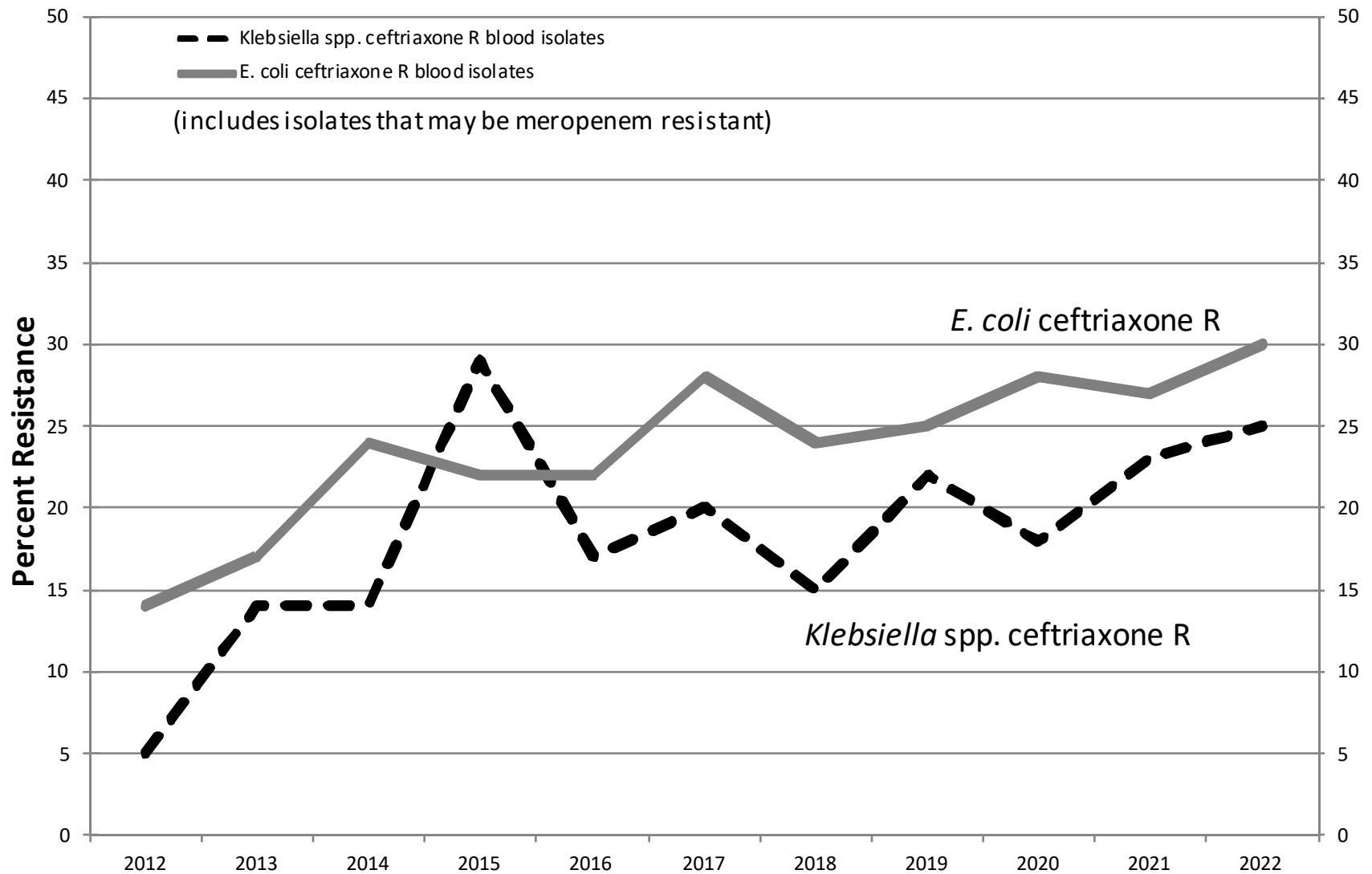
**NOTE:**

Resistance data trend from all sources

2012-2015: Derived from RRH data

2016-2022: Combined data from RRH and SMH

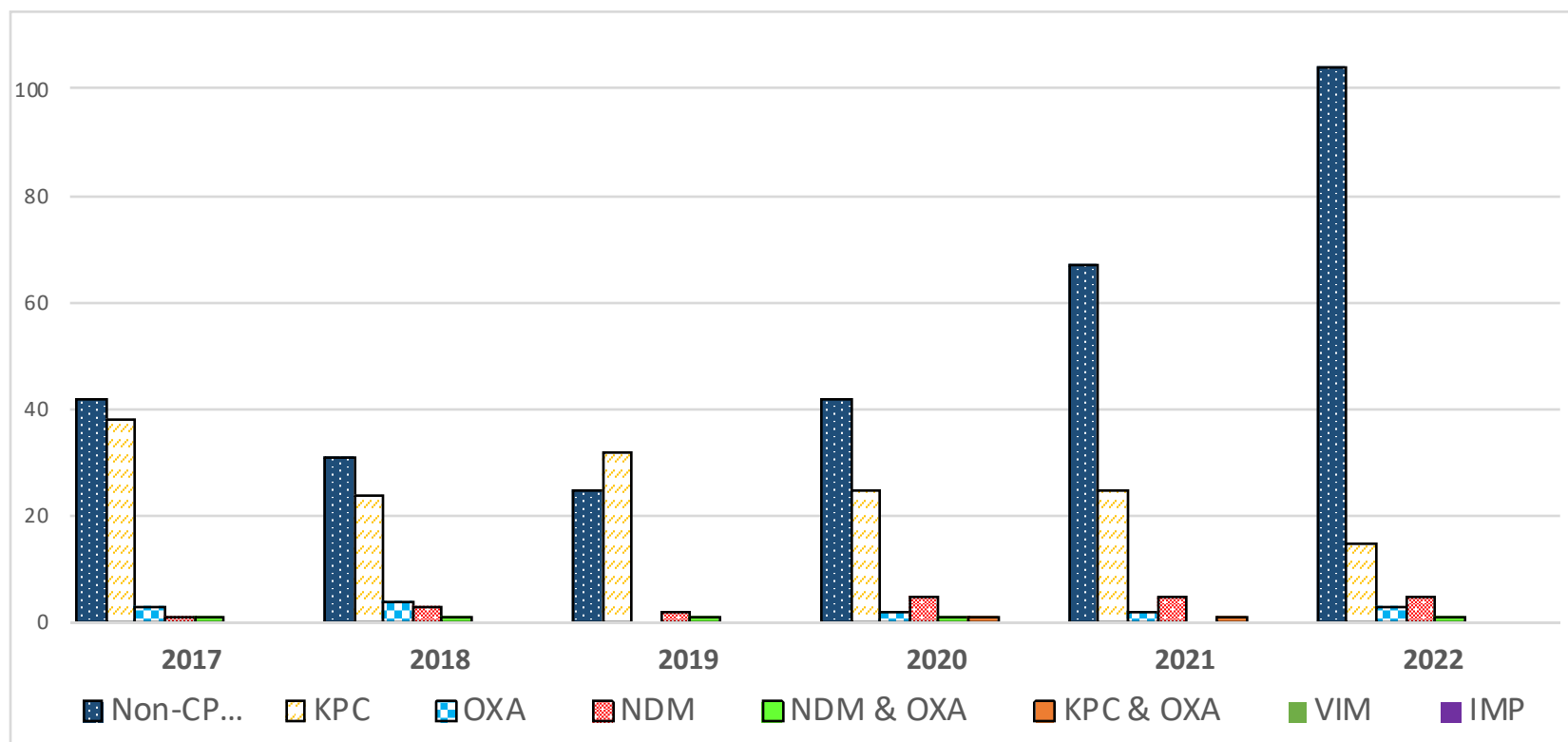
**Table 12. Resistance Trends: 1990-2022**  
(cont.)



Note: No data prior to 1998  
 2012-2015: Derived from RRH data  
 2016-2022: Combined data from RRH and SMH

**Table 13. Carbapenem-resistant Enterobacterales (CRE), 2017-2022**

Year	Non-CP CRE	KPC	OXA	NDM	NDM & OXA	KPC & OXA	VIM	IMP
2017	42	38	3	1	1	0	0	0
2018	31	24	4	3	1	0	0	0
2019	25	32	0	2	1	0	0	0
2020	42	25	2	5	1	1	0	0
2021	67	25	2	5	0	1	0	0
2022	104	15	3	5	1	0	0	0



**Table 14. Treatment Suggestions for Organisms for which Susceptibility Testing is not Routinely Performed**

Organism	Recommended	Alternate treatment	Comments / Also Effective
<i>Aerococcus urinae</i>	Amoxicillin	Levofloxacin or Ciprofloxacin	Fluoroquinolones resistant strains (27%-33%) have been reported. <sup>1</sup>
<i>Bordetella pertussis</i> <sup>2</sup>	Azithromycin or Clarithromycin	Trimethoprim-sulfamethoxazole	
<i>Campylobacter jejuni</i> <sup>2</sup>	Azithromycin	Consult with ID	Trimethoprim-sulfamethoxazole, Penicillin & Cephalosporins <b>NOT Active</b>
<i>Campylobacter fetus</i> <sup>2</sup>	Gentamicin	Imipenem or Ceftriaxone	Ampicillin
<i>Legionella spp.</i> <sup>2</sup>	Levofloxacin or Azithromycin	Moxifloxacin or doxycycline	
<i>Mycoplasma pneumoniae</i> <sup>2</sup>	Doxycycline	Azithromycin, Minocycline	Clindamycin & B-lactams <b>NOT Effective</b> . Increasing macrolide resistance.
<i>Mycoplasma hominis</i>	Consult with ID	Consult with ID	<b>Resistant</b> to Erythromycin and azithromycin. Fluoroquinolone and Tetracycline resistant strains have been reported. <sup>3</sup>
<i>Stenotrophomonas maltophilia</i> <sup>2,4</sup>	Trimethoprim-sulfamethoxazole	Minocycline <sup>5</sup> in high dose Consult with ID for serious infections.	Fluoroquinolone <sup>5</sup> Potential for resistance may emerge during levofloxacin therapy. Levofloxacin should not be used alone for antimicrobial therapy.
<i>Streptococcus agalactiae</i> (Group B Streptococcus)	Penicillin, Ampicillin, or Amoxicillin	Cefazolin or Vancomycin	
<i>Cutibacterium</i> ( <i>Propionibacterium</i> ) <i>acnes</i> <sup>2</sup>	Penicillin, Ceftriaxone	Vancomycin, Daptomycin, Linezolid	Resistant to Metronidazole
<i>Ureaplasma</i>	Azithromycin, Doxycycline		Resistant to Clindamycin. Tetracycline resistant strains have been reported. <sup>3</sup>

<sup>1</sup> Berteau, T., Roy, F. É., Bestman-Smith, J., Lapierre, S. G., Longtin, J., Dufresne, S. F., ... & Leduc, J. M. (2018, November). 2001. Susceptibility of *Aerococcus urinae* to Fluoroquinolones: Broth Microdilution and Gradient Diffusion. In *Open Forum Infectious Diseases* (Vol. 5, No. suppl\_1, pp. S582-S583). US: Oxford University Press.

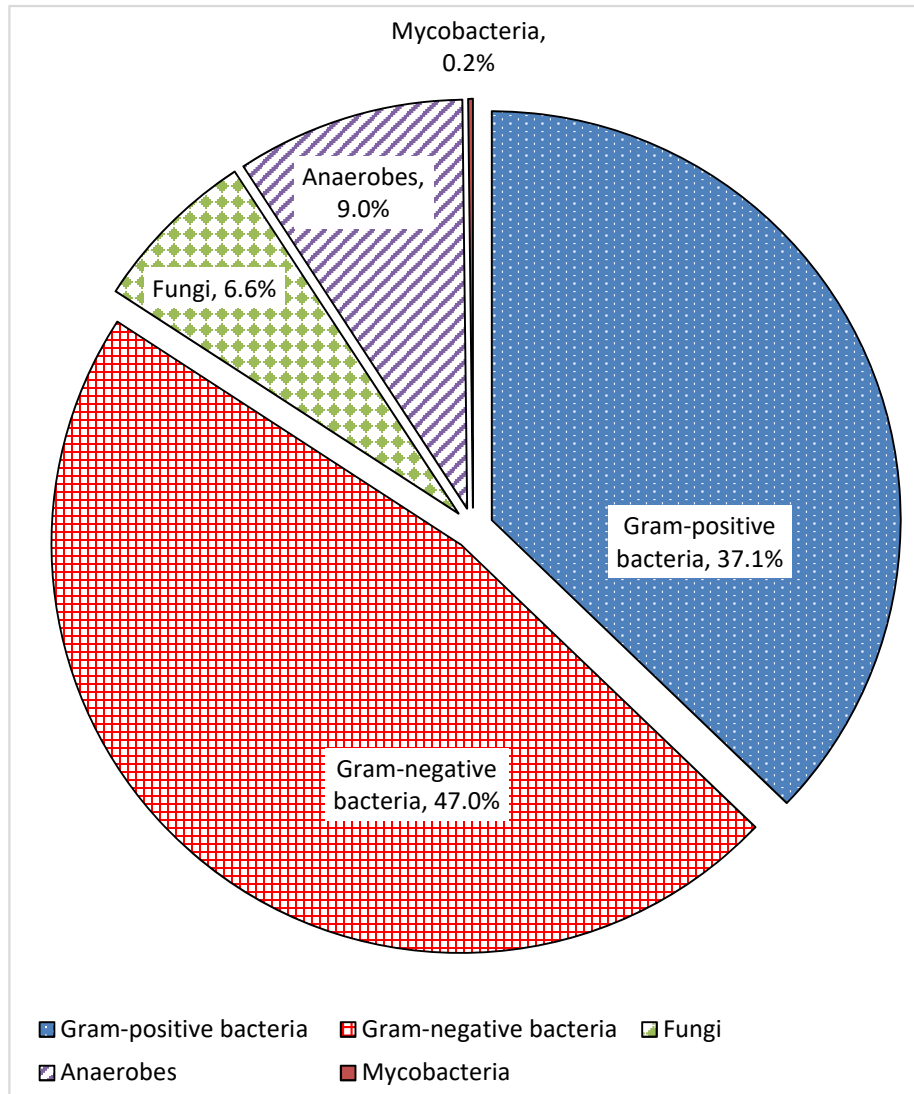
<sup>2</sup> The Sanford Guide to Antimicrobial Therapy. (2020). Sperryville, VA: Antimicrobial Therapy, Inc.

<sup>3</sup> Waites, K. B., Katz, B., & Schelonka, R. L. (2005). *Mycoplasmas* and *Ureaplasma* as neonatal pathogens. *Clinical microbiology reviews*, 18(4), 757–789.

<sup>4</sup> Susceptibility performed on *Stenotrophomonas maltophilia* isolates from sterile body sites and Cystic Fibrosis cases.

<sup>5</sup> Tamma, P., Aitken, S., Bonomo, R., Mathers, A., van Duin, D., & Clancy, C. (2021). IDSA guidance on the treatment of antimicrobial-resistant gram-negative infections: version 2.0. *Arlington, VA: IDSA*

**Table 15. Blood: One Isolate per Patient, 2022**



Most Common Organism	n	% of Total Blood Isolates
<i>Escherichia coli</i> , 28% ceftriaxone R	314	23%
<i>Staphylococcus aureus</i> , 29% MRSA	191	14%
<i>Enterococcus</i> spp., 30% VRE	180	13%
<i>Klebsiella</i> spp., 21% ceftriaxone R	157	12%
Viridans group <i>Streptococcus</i>	91	7%
Other <i>Enterobacteriaceae</i> spp.	54	4%
<i>Pseudomonas aeruginosa</i>	49	4%
<i>Proteus mirabilis</i>	47	3%
B-hemolytic <i>Streptococci</i> (Groups A, B, C & G)	43	3%
<i>Enterobacter cloacae</i> complex	38	3%
<i>Bacteroides</i> spp.	38	3%
<i>Candida albicans</i>	34	3%
<i>Candida glabrata</i>	29	2%
<i>Streptococcus anginosus</i> group	24	2%
<i>Candida parapsilosis</i>	16	1%
<i>Acinetobacter</i> spp.	15	1%
<i>Klebsiella (Enterobacter) aerogenes</i>	15	1%
<i>Stenotrophomonas maltophilia</i>	15	1%
<i>Serratia marcescens</i>	14	1%

**Total blood isolates \* 1661**

\*Excludes

Coagulase-negative *Staphylococcus* (n= 562)

*Corynebacterium* spp. (n= 65)

*Bacillus* spp. (n=21)

*Micrococcus* spp. (n= 28)

*Cutibacterium (Propionibacterium) acnes* (n=16)

**Table 15. Blood: One Isolate per Patient, 2022 (cont.)**

By Organism Group

<b>Gram-positive Bacterial Isolates*</b>			<b>Fungal Isolates</b>		
	<b>n</b>	<b>% of Gram-positive Isolates</b>		<b>n</b>	<b>% of Fungal Isolates</b>
<i>Staphylococcus aureus</i> , 29% MRSA	191	45%	<i>Candida albicans</i>	34	31%
<i>Enterococcus spp.</i> , 30% VRE	180	42%	<i>Candida glabrata</i>	29	27%
Viridans group <i>Streptococcus</i>	66	16%	<i>Candida parapsilosis</i>	16	15%
Other gram-positives	44	10%	Other Fungi	7	6%
Beta-hemolytic <i>Streptococcus</i>	43	10%	<i>Candida tropicalis</i>	7	6%
<i>Streptococcus anginosus</i> group	24	6%	<i>Cryptococcus neoformans</i>	3	3%
<i>Granulicatella spp.</i>	24	6%	<i>Candida auris</i>	6	6%
<i>Aerococcus spp.</i>	30	7%	<i>Candida krusei</i>	3	3%
<i>Staphylococcus lugdunensis</i>	7	2%	<i>Candida dubliniensis</i>	3	3%
<i>Streptococcus pneumoniae</i>	8	2%	<i>Candida guilliermondii</i>	2	2%
<b>Total</b>	<b>617</b>		<b>Total</b>	<b>110</b>	

\*Excludes other coagulase – negative *Staphylococcus*, *Corynebacterium spp.*, *Bacillus spp.*, *Micrococcus spp.*

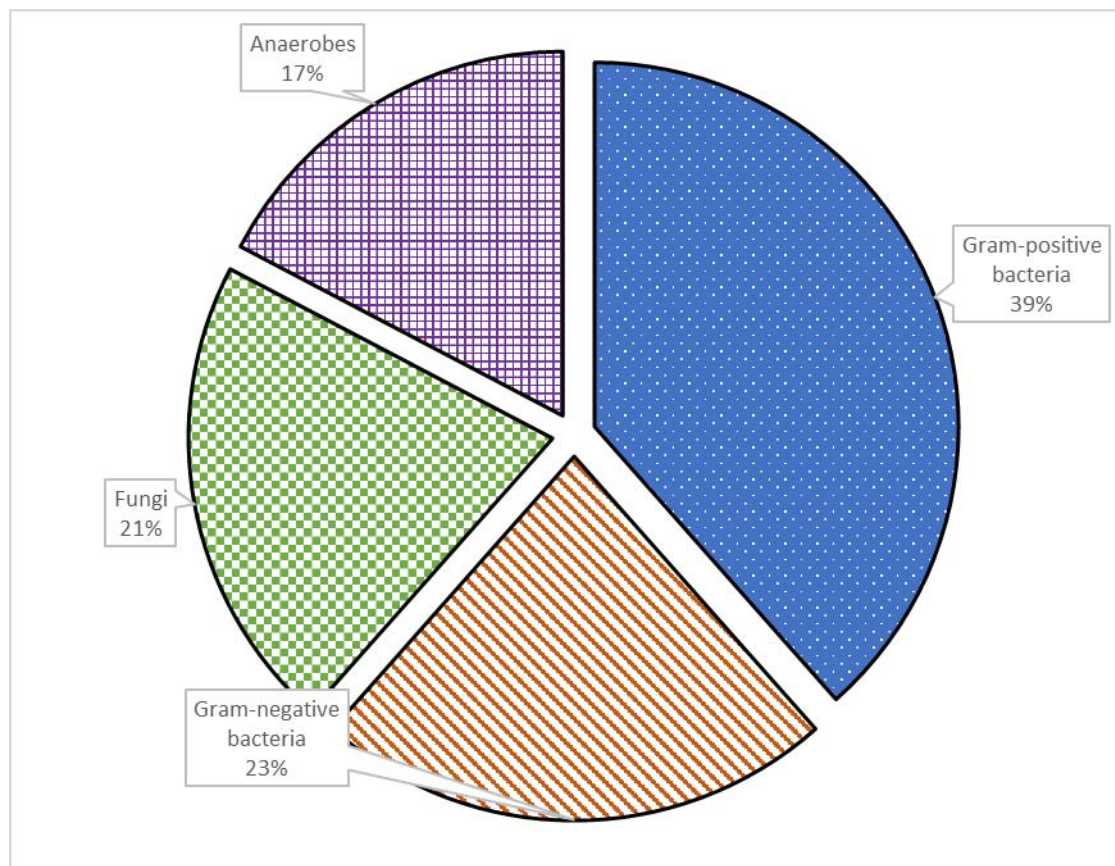
  

<b>Gram-negative Bacterial Isolates</b>			<b>Anaerobic Bacterial Isolates*</b>		
	<b>n</b>	<b>% of Gram-negative Isolates</b>		<b>n</b>	<b>% of Anaerobic Bacterial Isolates</b>
<i>Escherichia coli</i> , 28% ceftriaxone R	314	46%	<i>Bacteroides spp.</i> (includes Parabacteroides spp.)	38	28%
<i>Klebsiella spp.</i> , 25% ceftriaxone R	119	17%	Other anaerobes	25	19%
Other gram-negatives	81	12%	<i>Clostridium spp.</i>	13	10%
Other <i>Enterobacteriaceae spp.</i>	54	8%	<i>Lactobacillus spp.</i>	17	13%
<i>Pseudomonas aeruginosa</i>	49	7%	Other anaerobic Gram-negative rod	3	2%
<i>Enterobacter cloacae</i> complex	38	6%	<i>Fusobacterium spp.</i>	17	13%
<i>Proteus mirabilis</i>	47	7%	Other anaerobic Gram-positive cocci	14	10%
<i>Citrobacter spp.</i>	19	3%	<i>Prevotella spp.</i>	3	2%
<i>Serratia marcescens</i>	14	2%	Other anaerobic Gram-positive rod	6	4%
<i>Stenotrophomonas maltophilia</i>	15	2%	<i>Finegoldia magna</i>	7	5%
<i>Acinetobacter spp.</i>	15	2%	<i>Bifidobacterium species</i>	2	1%
<i>Klebsiella aerogenes</i>	15	2%	<i>Veillonella Spp.</i>	1	1%
<b>Total</b>	<b>780</b>		<i>Eggerthella lenta</i>	1	1%
			<i>Parvimonas micra</i>	3	2%
			*Excludes Cutibacterium acnes		
			<b>Total</b>	<b>150</b>	

<b>Mycobacterial Isolates</b>		
	<b>n</b>	<b>% of Mycobacterial Isolates</b>
<i>Mycobacterium abscessus</i>	1	33%
<i>Mycobacterium chelonae</i>	1	33%
<i>Mycobacterium fortuitum</i> group	1	33%
<b>Total</b>	<b>3</b>	

**Table 16. CSF: One Isolate per Patient, 2022**



n = 53

**Gram-positive bacteria (20)**

Organism	Number of Isolates
<i>Abiotrophia defectiva</i>	1
<i>Beta Streptococcus group G</i>	1
<i>Enterococcus faecalis</i>	2
<i>Enterococcus faecium</i>	2
<i>Staphylococcus aureus</i>	3
<i>Staphylococcus cohnii</i>	1
<i>Staphylococcus epidermidis</i>	1
<i>Staphylococcus hominis</i>	1
<i>Streptococcus parasanguinis</i>	1

**Gram-negative bacteria (12)**

Organism	Number of Isolates
<i>Citrobacter freundii complex</i>	1
<i>Escherichia coli</i>	3
<i>Klebsiella oxytoca</i>	1
<i>Klebsiella pneumoniae</i>	2
<i>Acinetobacter baumannii</i>	1
<i>Proteus mirabilis</i>	2
<i>Pseudomonas aeruginosa</i>	2

**Fungi (11)**

Organism	Number of Isolates
<i>Cryptococcus neoformans</i>	6
<i>Coccidioides immitis/posadasii</i>	2
<i>Candida albicans</i>	1
<i>Rhodotorula mucilaginosa</i>	1
<i>Candida parapsilosis</i>	1

**Anaerobic bacteria (9)**

Organism	Number of Isolates
<i>Cutibacterium acnes</i> ( <i>Propionibacterium acnes</i> )	8
<i>Actinomyces odontolyticus</i>	1

**Number of Isolates**

The following antimicrobial agents are not the drug of choice and may not be effective for treating infections caused by bacteria isolated from CSF:

- Agents administered by oral route only
- First- and second-generation cephalosporins and cephamycins
- Doripenem, ertapenem, and imipenem
- Clindamycin
- Lefamulin
- Macrolides
- Tetracyclines
- Fluoroquinolones



**Table 17. Mycobacteria, One Isolate per Patient per Source, 2022**

Organisms	No. of Isolates	# Patients By Source <sup>1</sup>		
		Respiratory	Abscess/ wound/ tissue/other	Blood
Mycobacterium avium complex	255	230	20	5
Mycobacterium mucogenicum	108	100	8	
Mycobacterium chelonae	34	22	11	1
Mycobacterium abscessus	30	22	7	1
Mycobacterium gordonae	25	20	5	
Mycobacterium fortuitum group	17	12	4	1
Mycobacterium tuberculosis complex	12	9	3	
Mycobacterium lentiflavum	4	4		
Mycobacterium kansasii	3	2	1	
Mycobacterium mageritense	2	2		
Mycobacterium xenopi	2	1	1	
Mycobacterium colombiense	2		1	1
Mycobacterium immunogenum	2		2	
Mycobacterium szulgai	1	1		
Mycobacterium cosmeticum	1	1		
Mycobacterium fortuitum	1	1		
Mycobacterium tuberculosis	1	1		
Mycobacterium neoaurum	1	1		
Mycobacterium goodii	1	1		
Mycobacterium scrofulaceum	1	1		
Mycobacterium simiae	1	1		
<b>Total Mycobacteria</b>	<b>504</b>	<b>432</b>	<b>63</b>	<b>9</b>

<sup>1</sup> Some patients have isolates in more than one source.

## Table 18. Mycobacteria Antimicrobial Susceptibility Testing

### 1. *Mycobacterium tuberculosis complex*:

Performed on first isolate per patient; performed on additional isolates recovered after 3 months, testing performed at reference lab.

Primary agents	Secondary agents
Rifampin	Amikacin
Isoniazid (INH)	Capreomycin
Pyrazinamide	Ciprofloxacin
Ethambutol	Ethionamide
	p-aminosalicylic acid
	Streptomycin

### 2. *Mycobacterium avium complex*:

Performed on first isolate per patient; performed on additional isolates recovered after 3 months, testing performed at reference lab.

Correlation between in vitro susceptibility and clinical response has been demonstrated only for clarithromycin. Clarithromycin results predict azithromycin results. Susceptibility testing for clarithromycin should be performed on isolates from patients only when failing prior macrolide therapy or prophylaxis.

### 3. Rapidly growing *Mycobacterium* spp. (e.g. *M. abscessus*, *M. chelonae*, and *M. fortuitum* group):

Performed on one isolate per patient, testing performed in-house. Additional agents on request.

Agents routinely reported	Agents conditionally reported
amikacin	imipenem
cefoxitin	linezolid
ciprofloxacin	meropenem
clarithromycin (inducible)	moxifloxacin
doxycycline	tigecycline
trimethoprim-sulfamethoxazole	tobramycin ( <i>M. chelonae</i> isolates only)

*M. abscessus* Clarithromycin and Amikacin drug resistance prediction and subspecies identification by Whole Genome Sequencing is performed by physician request only.

### 4. Other Nontuberculous Mycobacteria (NTM):

*M. kansasii* – Performed on one isolate per patient, at reference lab. Other NTM by physician request.

**Table 19. California Mycobacterium tuberculosis % Resistant, 2012-2022**

Data derived from California Department of Public Health Annual report "Report on Tuberculosis in California"<sup>1</sup>

Antimicrobial Agent	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Isoniazid	10.0%	10.6%	9.8%	10.9%	10.9%	7.6% <sup>2</sup>	ND	ND	ND	ND	ND
Rifampin	0.9%	1.8%	1.3%	1.4%	1.8%	0.4% <sup>2</sup>	ND	ND	ND	ND	ND
Ethambutol	0.9%	1.1%	0.8%	0.7%	ND	ND	ND	ND	ND	ND	ND
Pyrazinamide	6.7%	6.7%	5.5%	5.1%	5.4%	4.5% <sup>2</sup>	ND	ND	ND	ND	ND
Multi-drug Resistant Tuberculosis rates <sup>3</sup>	0.8%	1.6%	1.1%	1.3%	1.8%	1.8%	1.2%	1.0%	1.0%	0.6%	0.9
MTB Case rate per 100,000 population	5.7	5.6	5.5	5.5	5.2	5.2	5.3	5.3	4.3	4.4	4.7
Number of new cases	2186	2163	2130	2131	2059	2058	2092	2115	1706	1750	1843

<sup>1</sup> <https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/TB-Disease-Data.aspx>

<sup>2</sup> Excludes multi-drug resistant cases.

<sup>3</sup> Multi-drug resistant = Resistant to isoniazid and rifampin.

**Table 20. Rapid Grower – Mycobacteria % Susceptible 2021-2022**

Organism	No. Isolates	Amikacin	Cefoxitin	Ciprofloxacin	Clarithromycin	Doxycycline	Imipenem	Trimethoprim-sulfamethoxazole	Tobramycin
<i>Mycobacterium abscessus</i> complex <sup>1, 2, 3, 4</sup>	50	98	30	R	56	R	14	R	–
<i>Mycobacterium fortuitum</i>	52	99	14	97	11	28	100	97	–
<i>Mycobacterium chelonae</i>	29	98	0	2	99	8	21	2	99
<i>Mycobacterium mucogenicum</i>	150	99	99	99	99	93	99	99	–

<sup>1</sup> *M. abscessus* complex is differentiated into 3 subspecies: *M. abscessus* subsp. *abscessus*, *M. abscessus* subsp. *massiliense* and *M. abscessus* subsp. *bolletii*.

<sup>2</sup> Some isolates of *M. abscessus* subsp. *abscessus* and *M. abscessus* subsp. *bolletii* may contain a functional *erm(41)* gene that confers inducible macrolide resistance. Resistance is detected in MIC at day 15, which is routinely tested for.

<sup>3</sup> *M. abscessus* Clarithromycin and Amikacin drug resistance prediction and subspecies identification by Whole Genome Sequencing is available by physician request.

<sup>4</sup> Subspecies identification by Whole Genome Sequencing (2020 – 2022) n = 17 *M. abscessus* subsp. *abscessus* = 59%, *M. abscessus* subsp. *massiliense* = 41%, *M. abscessus* subsp. *bolletii* = 0%.

**Table 21. CLSI Anaerobic Bacteria Cumulative Antibiogram, % Susceptible**

Data derived from CLSI M100S 33<sup>rd</sup> edition<sup>1,2</sup>

<i>Bacteroides</i> spp. and <i>Parabacteroides</i> spp.	Ampicillin–Sulbactam		Piperacillin–Tazobactam		Cefoxitin		Ertapenem		Imipenem		Meropenem		Clindamycin		Moxifloxacin		Metronidazole	
	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S
<b>Breakpoints %S</b>		≤8/4		≤16/4		≤16		≤4		≤4		≤4		≤2		≤2		≤8
<i>Bacteroides fragilis</i>	129	84	1030	96	830	100	133	82	189	97	1505	93	1013	26	256	61	1140	100
<i>Bacteroides thetaiotaomicron</i>	76	82	252	87	258	13	—	—	70	100	328	99	328	28	70	54	322	100
<i>Bacteroides ovatus</i>	30	80	206	94	177	20	19 <sup>2</sup>	84 <sup>2</sup>	49	100	236	95	207	46	59	41	236	100
<i>Bacteroides vulgatus</i>	20 <sup>3</sup>	45	168	92	153	73	—	—	35	97	171	96	171	53	29 <sup>2</sup>	31	186	100
<i>Bacteroides uniformis</i>	19 <sup>2</sup>	84	78	96	72	85	—	—	19 <sup>2</sup>	100	93	100	87	45	25 <sup>2</sup>	48	89	100
<i>Parabacteroides distasonis</i>	27 <sup>2</sup>	59 <sup>2</sup>	92	95	82	29	—	—	26 <sup>2</sup>	100	119	97	108	43	37	62	118	100

Other Anaerobic Organisms	Ampicillin–Sulbactam		Piperacillin–Tazobactam		Imipenem		Meropenem		Penicillin		Clindamycin		Moxifloxacin		Metronidazole	
	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S	No. Isolates	%S
<b>Breakpoints %S</b>		≤8/4		≤32/4		≤4		≤4		≤0.5		≤2		≤2		≤8
<i>Prevotella</i> species	29 <sup>2</sup>	97 <sup>2</sup>	63	100	29	100	92	98	63	100	29 <sup>2</sup>	69 <sup>2</sup>	92	66	92	99
<i>Fusobacterium</i> species	20 <sup>2</sup>	100 <sup>2</sup>	55	96	75	95	20 <sup>2</sup>	100 <sup>2</sup>	—	—	75	77	75	68	75	95
Anaerobic gram-positive cocci <sup>4</sup>	—	—	1853	99	134	99	1647	100	1647	100	1826	97	300	72	1692	100
<i>Cutibacterium (Propionibacterium) acnes</i>	—	—	18 <sup>2</sup>	100 <sup>2</sup>	17 <sup>2</sup>	94 <sup>2</sup>	—	—	—	—	17 <sup>2</sup>	53 <sup>2</sup>	114	95	18 <sup>2</sup>	0 <sup>2</sup>
<i>Clostridium perfringens</i>	15 <sup>2</sup>	100 <sup>2</sup>	410	100	23 <sup>2</sup>	100	417	100	402	90	425	83	23 <sup>2</sup>	83	425	100
Other <i>Clostridium</i> species	—	—	439	94	71	99	390	100	390	69	461	67	71	62	461	100

<sup>1</sup> CLSI. Performance Standards for Antimicrobial Susceptibility Testing. 33<sup>rd</sup> ed. CLSI Supplement M100. Clinical and Laboratory Standards Institute; 2023.

<sup>2</sup> Isolates collected from selected US hospitals from January 1<sup>st</sup>, 2013 to December 31<sup>st</sup>, 2016.

<sup>3</sup> Calculated from fewer than the standard recommendation of 30 isolates.

<sup>4</sup> Anaerobic gram-positive cocci include *Peptococcus*, *Peptostreptococcus*, *Fingoldia*, *Peptoniphilus*, and *Anaerococcus* species.

**Table 22. Antimicrobials (IV,PO) Formulary Status and Cost Reference**

Drug	Usual Dose	Usual Interval	(\$)*Per Day
<b>Penicillins</b>			
Ampicillin	1 gm	Q6H	32.90
Ampicillin	2 gm	Q6H	35.35
Ampicillin-sulbactam	3 gm	Q6H	49.20
Oxacillin(24-hr infusion)	12 gm	Q24H	124.60
Penicillin G (24-hr infusion)	24 million units	Q24H	47.75
Piperacillin-tazobactam (Extended 4-hr infusion)	4.5 gm	Q8H	36.90
Amoxicillin (PO)	500 mg	Q8H	0.30
Amoxicillin- clavulanic acid (PO)	500 mg	Q8H	1.35
Amoxicillin- clavulanic acid (PO)	875 mg	Q12H	1.75
<b>Cephalosporins</b>			
Cefazolin	1 gm	Q8H	10.75
Cefazolin	2 gm	Q8H	21.10
Cefepime <sup>1,2</sup>	1 gm	Q8H	28.05
Cefepime <sup>1,2</sup>	2 gm	Q8H	44.00
Cefoxitin (peri-operative only) <sup>1,3</sup>	2 gm	once	10.40
Ceftriaxone	1 gm	Q24H	9.50
Ceftriaxone	2 gm	Q24H	18.35
Cephalexin (PO)	500 mg	Q6H	0.95
Cefpodoxime (PO-UTI)	100 mg	Q12H	6.85
Cefpodoxime (PO)	200 mg	Q12H	4.60
<b>Carbapenems/monobactam</b>			
Aztreonam <sup>1,4</sup>	2 gm	Q8H	172.30
Ertapenem <sup>1,5</sup>	1 gm	Q24H	28.25
Meropenem <sup>1,6</sup>	1 gm	Q8H	29.90
<b>Aminoglycosides</b>			
Amikacin <sup>1,7</sup>	1000 mg (15 mg/kg/dose)	Q24H	11.15
Gentamicin	500 mg (7 mg/kg/dose)	Q24H	21.50
Tobramycin <sup>1,8</sup>	500 mg (7 mg/kg/dose)	Q24H	11.15

**Table 22. Antimicrobials (IV,PO) Formulary Status and Cost Reference**  
(cont.)

Drug	Usual Dose	Usual Interval	(\$)*Per Day
<b>Other Antimicrobials (Intravenous)</b>			
Azithromycin	500 mg	Q24H	34.85
Ciprofloxacin	400 mg	Q12H	5.30
Clindamycin	600 mg	Q8H	27.50
Colistimethate <sup>1,9</sup>	150 mg (CBA)**	Q12H	52.60
Daptomycin <sup>1,10</sup>	500 mg	Q24H	32.85
Doxycycline	100 mg	Q12H	36.85
Levofloxacin <sup>1,11</sup>	750 mg	Q24H	2.00
Linezolid <sup>1,12</sup>	600 mg	Q12H	20.20
Metronidazole	500 mg	Q8H	4.30
Rifampin <sup>1,13</sup>	600 mg	Q24H	166.45
Tigecycline <sup>1,9</sup>	50 mg	Q12H	57.00
TMP/SMX***	320 mg TMP	Q12H	35.70
Vancomycin	1 gm	Q12H	17.55
<b>Other Antimicrobials (Oral)</b>			
Azithromycin (PO)	500 mg	Q24H	2.70
Ciprofloxacin (PO)	500 mg	Q12H	0.30
Clarithromycin (PO)	500 mg	Q12H	3.65
Clindamycin (PO)	600 mg	Q8H	1.15
Doxycycline (PO)	100 mg	Q12H	5.15
Levofloxacin (PO) <sup>1,12</sup>	750 mg	Q24H	0.35
Linezolid (PO) <sup>1,13</sup>	600 mg	Q12H	3.35
Metronidazole (PO)	500 mg	Q8H	1.25
Nitrofurantoin (PO) (monohydrate/ macrocrystal formulation)	100 mg	Q12H	4.00
Rifampin (PO)	600 mg	Q24H	1.30
TMP/SMX (PO)	160 mg/800 mg	Q12H	0.25
Vancomycin (PO-cap)	125 mg	Q6H	4.00
Vancomycin (PO-susp)	125 mg	Q6H	8.95

**Table 22. Antimicrobials (IV,PO) Formulary Status and Cost Reference**  
(cont.)

Drug	Usual Dose	Usual Interval	(\$)*Per Day
<b>Antifungal Agents (Intravenous)</b>			
Amphotericin B	50 mg	Q24H	36.60
Amphotericin B <sup>1,10</sup> Liposomal (AmBisome)	400 mg	Q24H	730.70
Micafungin <sup>1,10</sup>	50 mg	Q24H	19.40
Micafungin <sup>1,10</sup>	100 mg	Q24H	34.65
Fluconazole	400 mg	Q24H	15.60
Isavuconazonium <sup>1,9</sup>	372 mg	Q24H	316.05
Posaconazole <sup>1,5,13,14</sup>	300 mg	Q24H	484.60
Voriconazole <sup>1,15</sup>	300 mg	Q12H	80.50
<b>Antifungal Agents (Oral)</b>			
Fluconazole (PO)	400 mg	Q24H	3.25
Isavuconazonium (PO) <sup>1,9</sup>	372 mg	Q24H	182.55
Posaconazole (PO-DR) <sup>1,5,14</sup>	300 mg	Q24H	48.45
Voriconazole (PO) <sup>1,15</sup>	200 mg	Q12H	31.15

\* Includes drug acquisition cost plus estimated preparation and administrative costs; charges rounded up to the nearest \$0.05

\*\* CBA: Colistin-base activity

\*\*\* TMP/SMX: Trimethoprim/Sulfamethoxazole

<sup>1</sup> Use of Controlled Formulary (CF) antimicrobials is restricted to UCLA Health System-approved criteria.

<sup>2</sup> Restricted: suspected or documented *Pseudomonas aeruginosa* infection and in the management of gram-negative meningitis.

<sup>3</sup> Restricted: surgical prophylaxis; refer to Pre-incisional Antimicrobial Recommendations.

<sup>4</sup> Restricted: aerobic gram-negative infections in beta-lactam allergic patients.

<sup>5</sup> For Pediatric patients: restricted to use by Pediatric Infectious Diseases Service approval.

<sup>6</sup> Restricted: clinical deterioration on concurrent/recent antimicrobials or febrile neutropenia and/or overt sepsis in an immunocompromised patient.

<sup>7</sup> Restricted: organisms with suspected/documentated resistance to gentamicin and tobramycin.

<sup>8</sup> Restricted: infections caused by organisms with suspected/documentated resistance to gentamicin.

<sup>9</sup> Restricted: requires formal consultation by an Infectious Diseases physician.

<sup>10</sup> Restricted to use by Adult or Pediatric Infectious Diseases Service approval.

<sup>11</sup> Restricted: all services, lower respiratory tract infections where RESISTANT organisms are suspected (e.g. penicillin- and cephalosporin-resistant *S. pneumoniae*).

<sup>12</sup> Restricted: suspected or documented VRE infection, documented allergy to vancomycin (not Redman's Syndrome).

<sup>13</sup> Injection: For use in patients unable to tolerate the oral formulations.

<sup>14</sup> For prophylaxis of invasive *Aspergillus* and *Candida* infections in severely immunocompromised patients.

<sup>15</sup> Restricted: treatment of suspected/documentated invasive aspergillosis. For treatment of infections caused by *S. apiospermum*, *Fusarium* species (including *F. solani*) and non-albicans *Candida* species in patients intolerant of, or refractory to other therapy.



## Table 23. Indications for Performing Routine Antimicrobial Susceptibility Tests – Aerobic Bacteria

Susceptibility tests will be performed as follows:

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### 1. Blood—all isolates except\*:

- Aerococcus* spp.<sup>1</sup> (excludes *Aerococcus urinae*)
- Bacillus* spp.<sup>1</sup>
- Corynebacterium* spp.<sup>1</sup> (excludes *Corynebacterium jeikeium* and *Corynebacterium striatum*)
- Coagulase-negative *Staphylococcus*<sup>1,2</sup>
- Cutibacterium (Propionibacterium) acnes*<sup>1</sup>
- Micrococcus* spp.<sup>1</sup>
- Viridans group *Streptococcus*<sup>1</sup> (excludes *Streptococcus anginosus* group)

### 2. Urine

>10<sup>5</sup> CFU/ml (1 or 2 species)

>50,000 CFU/ml (pure culture):

- Gram-negative bacilli; *Staphylococcus aureus*

**Urine from Urology – Susceptibility performed based on the following criteria upon request**

Workup for up to 5 organisms;

Any quantity of pathogens

- Gram-negative bacilli
- *Staphylococcus aureus*

Potential pathogens – Colony count of ≥50K for ≤2 organisms

- Coagulase Negative *Staphylococcus*
- Viridans *Streptococcus*
- *Corynebacterium* species
- Yeast
- *Staphylococcus saprophyticus*
- *Aerococcus* species
- Beta hemolytic *Streptococcus*

*Enterococcus* species

- ≤2 organism any quantity
- Colony count of <50K Predominant in mix culture
- Colony count of ≥50K Non-predominant in mixed culture

### 3. Respiratory (sputum, nasopharynx, bronchial washing and tracheal aspirate):

Moderate /many growth ≤2 potential pathogens

Cystic fibrosis patients: any quantity of gram-negative bacilli, *S. aureus*, *S. pneumoniae*

### 4. Stool

*Salmonella* spp. (≤ 3 mo. only or susceptibilities performed on all isolates of *S. typhi* and *S. paratyphi*)

*Shigella* spp.

*Yersinia* spp.

*Vibrio* spp.

\* Neonates (≤3 months), susceptibilities performed on all isolates

<sup>1</sup> Susceptibilities performed if isolated from multiple cultures

<sup>2</sup> Susceptibilities performed on all isolates of *S. lugdunensis*

**Table 23. Indications for Performing Routine Antimicrobial Susceptibility Tests – Aerobic Bacteria**  
(cont.)

5. Wounds, abscesses and other contaminated body sites, ≤2 potential pathogens.
6. If isolate is from sterile body site, susceptibility testing will be performed on subsequent isolates from similar site(s) every 3 days. Exception: *S. aureus* and *P. aeruginosa* tested each day of collection from blood.
7. If isolate is from non-sterile body site, susceptibility testing will be performed on subsequent isolates from similar site(s) every 5 days.

**Additional notes:**

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- Susceptibility tests will not be performed on more than two potential pathogens per culture unless specifically requested following discussion with clinician.
- Blood and CSF isolates are held for 1 year.
- Other potentially significant isolates are held in lab for 7 days. Contact lab at (310) 794-2758 within 48 hours if susceptibilities are desired.

**Table 24. Antimicrobial Agents Routinely Reported – Aerobic Bacteria**

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s) <sup>1</sup>
<b><i>E. coli</i>, <i>Klebsiella</i> spp., <i>P. mirabilis</i> – Excludes urine isolates</b>		
ceftriaxone	Resistant to ceftriaxone Resistant to ertapenem (>18 y.o.)	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.) imipenem, meropenem
ciprofloxacin (>11 y.o.) gentamicin piperacillin-tazobactam trimethoprim-sulfamethoxazole	Resistant to gentamicin Resistant to piperacillin-tazobactam	amikacin, tobramycin ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.)
<b><i>E. coli</i>, <i>Klebsiella</i> spp., <i>P. mirabilis</i> – Urine isolates</b>		
ampicillin oral cephalosporins <sup>2</sup> ceftriaxone	Resistant to ceftriaxone Resistant to ertapenem (>18 y.o.)	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.) imipenem, meropenem
ciprofloxacin (>11 y.o.) gentamicin nitrofurantoin piperacillin-tazobactam trimethoprim-sulfamethoxazole	Resistant to gentamicin  Resistant to piperacillin-tazobactam	tobramycin  ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.)
<b>Other Enterobacterales organisms<sup>3</sup> – Excludes urine isolates</b>		
cefepime	Resistant to cefepime Resistant to ertapenem (>18 y.o.)	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.) imipenem, meropenem
ceftriaxone ciprofloxacin (>11 y.o.) gentamicin piperacillin-tazobactam <sup>5</sup> trimethoprim-sulfamethoxazole	Resistant to gentamicin Resistant to piperacillin-tazobactam	amikacin, tobramycin ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.)
<b>Other Enterobacterales organisms<sup>3</sup> – Urine isolates</b>		
ampicillin cefepime	Resistant to cefepime Resistant to ertapenem (>18 y.o.)	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.) imipenem, meropenem
ceftriaxone ciprofloxacin (>11 y.o.) gentamicin nitrofurantoin piperacillin-tazobactam <sup>5</sup> trimethoprim-sulfamethoxazole	Not reported for some HECK-Yes organisms <sup>4</sup>  Resistant to gentamicin  Resistant to piperacillin-tazobactam	  amikacin  ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o.)

<sup>1</sup> The following additional antimicrobial agents are reported on carbapenem resistant Enterobacterales (resistant to meropenem and/or imipenem): azteonam, azithromycin, minocycline, moxifloxacin, tigecycline, ceftazidime-avibactam and ceftolozane-tazobactam.

<sup>2</sup> Cefazolin results should only be used to predict potential effectiveness of oral cephalosporins for uncomplicated UTIs.

<sup>3</sup> *Enterobacterales* other than *E. coli*, *Klebsiella* spp., *P. mirabilis*, *Salmonella* spp., *Shigella* spp.

<sup>4</sup> Ceftriaxone not reported for *Citrobacter freundii* complex, *Enterobacter cloacae* complex and *Klebsiella aerogenes*.

**Table 24. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)**

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s) <sup>1</sup>
<b><i>Salmonella</i> spp.,<sup>1</sup> <i>Shigella</i> spp.<sup>2</sup></b>		
ciprofloxacin (>11 y.o.) trimethoprim-sulfamethoxazole	<i>Shigella</i> spp. Non-fecal sources/resistant to all primary antimicrobials	azithromycin ceftriaxone
<b><i>Pseudomonas aeruginosa</i></b>		
cefepime	Resistant to cefepime	imipenem, meropenem, ceftolozane - tazobactam
	Resistant to imipenem or meropenem	ceftolozane - tazobactam
ciprofloxacin (>11 y.o.) Tobramycin piperacillin-tazobactam ceftazidime	ceftolozane – tazobactam MIC ≥4 µg/mL  Urine Resistant to piperacillin-tazobactam	cefiderocol  amikacin imipenem, meropenem
<b><i>Acinetobacter</i> spp.</b>		
cefepime ceftazidime ciprofloxacin (>11 y.o.)	Resistant to ceftazidime	imipenem, meropenem
gentamicin piperacillin-tazobactam trimethoprim-sulfamethoxazole	Resistant to meropenem or imipenem Resistant to gentamicin	minocycline amikacin, tobramycin
<b><i>Stenotrophomonas maltophilia</i>- Sterile body site isolates</b>		
<b><i>Burkholderia cepacia</i> complex</b>		
levofloxacin (>11 y.o.) minocycline trimethoprim-sulfamethoxazole	<i>Burkholderia cepacia</i> complex <i>Burkholderia cepacia</i> complex	meropenem ceftazidime

<sup>1</sup> If stool isolates, perform on patients ≤3 mo., or if isolate is *Salmonella typhi* or *Salmonella paratyphi* A.

<sup>2</sup> Susceptibility performed on stool isolates.

**Table 24. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)**

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)
<b>Nonfermenting Gram Negative Rods not otherwise listed</b>		
cefepime		
ceftazidime	Resistant to ceftazidime	imipenem, meropenem
ciprofloxacin (>11 y.o.)		
gentamicin	If gentamicin >1 µg/ml	amikacin, tobramycin
piperacillin-tazobactam		
trimethoprim-sulfamethoxazole		
<b><i>Haemophilus influenzae</i></b>		
Beta-lactamase test	Sterile body site isolates:	Reported upon request:
	If beta-lactamase positive	ceftriaxone
	If beta-lactamase negative	ampicillin, ceftriaxone
	CSF only	Meropenem

**Table 24. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)**

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)
<b><i>Staphylococcus spp.</i></b>		
clindamycin <sup>1</sup>		
oxacillin	<i>S. aureus</i> (exclude Blood and CSF) Resistant to oxacillin (MRSA)	tetracycline/doxycycline, trimethoprim-sulfamethoxazole All beta-lactams considered resistant except ceftaroline
penicillin		
vancomycin	<i>S. aureus</i> on blood (vancomycin $\geq 2\mu\text{g/ml}$ ) Urine isolates	daptomycin, linezolid ciprofloxacin <sup>2</sup> , nitrofurantoin, trimethoprim-sulfamethoxazole
<b><i>Enterococcus spp.</i></b>		
ampicillin		
vancomycin	Resistant to vancomycin (VRE) from sterile body sites Sterile body site isolates Urine isolates	daptomycin, doxycycline, linezolid, quinupristin-dalfopristin (excluding <i>E. faecalis</i> ), rifampin gentamicin (high level) ciprofloxacin <sup>2</sup> , doxycycline, nitrofurantoin
<b><i>Streptococcus pneumoniae</i></b>		
amoxicillin, cefotaxime, ceftriaxone, erythromycin <sup>3</sup> , levofloxacin <sup>2</sup> , penicillin, tetracycline <sup>3</sup> , trimethoprim-sulfamethoxazole <sup>3</sup> , vancomycin		
<b>Viridans group <i>Streptococcus</i></b>		
cefotaxime, ceftriaxone, penicillin, vancomycin		
<b>Beta-hemolytic <i>Streptococcus</i></b>		
Clindamycin <sup>1</sup> , penicillin, vancomycin		
<b><i>Listeria monocytogenes</i></b>		
penicillin, trimethoprim-sulfamethoxazole (penicillin results predicts ampicillin results)		

<sup>1</sup> Excluding urine and CSF isolates

<sup>2</sup> Patients >11 y.o.

<sup>3</sup> Excluding CSF isolates

**Table 25: CLSI M62 – Expected Antimicrobial Susceptibility Patterns of the Most Commonly Isolated Nocardia Data Derived from CLSI M62†**

Organism	Amoxicillin/ clavulanic acid	Ceftriaxone	Imipenem	Ciprofloxacin	Minocycline	Linezolid	Trimethoprim – sulfamethoxazole	Amikacin	Tobramycin	Clarithromycin
<i>N. cyriacigeorgica</i>	R	S	S	R	V	S	S	S	S	R
<i>N. abscessus</i>	S	S	V	R	V	S	S	S	V	R
<i>N. nova complex*</i>	R	S	S	R	V	S	S	S	R	S
<i>N. transvalensis complex**</i>	V	S	V	S	V	S	S	R	R	R
<i>N. farcinica</i>	S	R	V	S	V	S	S	S	R	R
<i>N. brasiliensis</i>	S	V	R	R	S	S	S	S	S	R
<i>N. pseudobrasiliensis</i>	R	V	R	S	R	S	S	S	S	S
<i>N. otitdiscaviarum</i>	R	R	R	S	V	S	S	S	V	V

† Adapted from CLSI M62 1st edition, Nov 2018

\* *N. nova complex* includes *N. africana*, *N. elegans*, *N.*, *kruczakiae*, *N. nova*, and *N. veterana*

\*\* *N. transvalensis complex* include *N. blacklockiae*, *N. transvalnesis*, and *N. wallacei*

**Table 26. Susceptible MIC ( $\mu\text{g/mL}$ ) Breakpoints for Aerobic Gram-negative Bacilli †**

	Penicillins			Cephalosporins					Carbapenems			Amino-glycosides			Fluoro-quinolones		Other								
	Ampicillin	Ampicillin-sulbactam	Piperacillin-tazobactam	Cefazolin	Cefepime	Cefotaxime	Ceftazidime	Ceftriaxone	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin <sup>1</sup>	Levofloxacin <sup>2</sup>	Colistin <sup>3</sup>	Trimethoprim – sulfamethoxazole	Nitrofurantoin	Minocycline	Tigecycline	Ceftolozane-tazobactam	Ceftazidime-avibactam	Meropenem-vaborbactam	
<i>Enterobacterales</i>	≤8	≤8	≤8	≤2	≤2	≤1	≤4	≤1	≤0.5	≤1	≤1	≤4	≤2	≤2	≤0.25	≤0.5	≤2	≤2/38	≤32	≤4	≤2	≤2/4	≤8/4	≤4/8	
<b>NONFERMENTERS</b>																									
<i>Acinetobacter species</i>	R	≤8	≤16	R	≤8	≤8	≤8	≤8	R	≤2	≤2	≤16	≤4	≤4	≤1	≤2	≤2	≤2/38	–	≤4	–	–	–	–	
<i>Burkholderia cepacia complex</i>	R	R	R	R	R	–	≤8	R	R	R	≤4	R	R	R	–	≤2	R	≤2/38	–	≤4	–	–	–	–	
<i>Pseudomonas aeruginosa</i>	R	R	≤16	R	≤8	R	≤8	R	R	≤2	≤2	≤16 <sup>4</sup>	≤4	≤4	≤0.5	≤1	≤2	R	–	–	R	≤4/4	≤8/4	–	
<i>Stenotrophomonas maltophilia</i>	R	R	R	R	–	R	≤8	R	R	R	R	R	R	R	–	≤2	–	≤2/38	–	≤4	–	–	–	–	
Other non-fermenters	–	–	≤16	–	≤8	≤8	≤8	≤8	–	≤4	≤4	≤16	≤4	≤4	≤1	≤2	–	≤2/38	–	≤4	–	–	–	–	

† Data derived from CLSI M100 33<sup>rd</sup> edition.

<sup>1</sup> *Salmonella* spp. breakpoint for ciprofloxacin ≤ 0.06  $\mu\text{g/ml}$

<sup>2</sup> *Salmonella* spp. breakpoint for levofloxacin ≤ 0.12  $\mu\text{g/ml}$

<sup>3</sup> There are no susceptible category for colistin. The MIC is based on the new CLSI Intermediate breakpoint at for Colistin at ≤ 2  $\mu\text{g/mL}$

<sup>4</sup> Amikacin breakpoints for *Pseudomonas aeruginosa* for Urine sources only.



**Table 27. Susceptible MIC ( $\mu\text{g/mL}$ ) Breakpoints for Aerobic Gram-positive Cocci†**

Organism	Penicillins			Cephalo- sporin	Aminogly- cosides		Fluoro- quinolone	Other									
	Ampicillin	Oxacillin	Penicillin	Ceftaroline <sup>1</sup>	Gentamicin	Gentamicin synergy	Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Nitrofurantoin	Quinupristin- dalbapristin	Rifampin	Trimethoprim – sulfamethoxazole	Vancomycin
<i>Staphylococcus aureus</i> <i>Staphylococcus lugdunensis</i>	– <sup>1</sup>	$\leq 2$	$\leq 0.12^2$	$\leq 1$	$\leq 4$	–	$\leq 1$	$\leq 0.5$	$\leq 1$	$\leq 4$	$\leq 0.5$	$\leq 4$	$\leq 32$	$\leq 1$	$\leq 1$	$\leq 2/38$	$\leq 2^1$
Coagulase-negative <i>Staphylococcus</i>	–	$\leq 0.5$	$\leq 0.12^2$	–	$\leq 4$	–	$\leq 1$	$\leq 0.5$	$\leq 1$	$\leq 4$	$\leq 0.5$	$\leq 4$	$\leq 32$	$\leq 1$	$\leq 1$	$\leq 2/38$	$\leq 4$
<i>Enterococcus</i> spp. <i>Enterococcus faecalis</i>	$\leq 8$	–	$\leq 8$	R	R	$\leq 500$	$\leq 1$	R	$\leq 2$	$\leq 4$	R	$\leq 2$	$\leq 32$	$\leq 1$	$\leq 1$	R	$\leq 4$
<i>Enterococcus faecium</i>	$\leq 8$	–	$\leq 8$	R	R	$\leq 500$	$\leq 1$	R	$\leq 4$	$\leq 4$	R	$\leq 2$	$\leq 32$	$\leq 1$	$\leq 1$	R	$\leq 4$

Organism	Penicillins		Cephalosporins		Tetracyclines		Other		
	Amoxicillin	Penicillin	Cefotaxime	Ceftriaxone	Doxycycline	Tetracycline	Erythromycin	Levofloxacin	Vancomycin
<i>Streptococcus pneumoniae</i>	–	–	–	–	$\leq 0.25$	$\leq 1$	–	$\leq 2$	$\leq 1$
Meningitis	–	$\leq 0.06$	$\leq 0.5$	$\leq 0.5$	–	–	–	–	–
Non-meningitis	$\leq 2$	$\leq 2$	$\leq 1$	$\leq 1$	–	–	$\leq 0.25$	–	–
Viridans group <i>Streptococcus</i>	–	$\leq 0.12$	$\leq 1$	$\leq 1$	–	–	–	–	$\leq 1$

† Data derived from CLSI M100 33<sup>rd</sup> edition.

1 *S. aureus* only, including MRSA

2 beta-lactamase negative

## Table 28. Antimicrobial Stewardship

- 1) Treatment of asymptomatic bacteriuria
  - a. A urine culture must ALWAYS be interpreted in the context of the urinalysis and patient symptoms.
  - b. If a patient has no signs of infection on urinalysis and no symptoms of infection, but a positive urine culture, the patient by definition has **asymptomatic bacteriuria**.
  - c. Patients with chronic indwelling catheters, urinary stoma, and neobladders will almost universally have positive urine cultures.
  - d. The only patient populations for which it is recommended to screen for and treat asymptomatic bacteriuria are **pregnant women** and **patients scheduled for a genitourinary surgical procedure**. Screening during the first 2 months of renal transplant is acceptable.
  - e. Avoid routine urine analysis and/or urine cultures for the sole purpose of screening for UTI in asymptomatic patients.
- 2) Treatment of VRE Isolated from stool cultures
  - a. *Enterococcus* are normal bowel flora and do not cause enteric infections, regardless of vancomycin susceptibility.
  - b. Antibiotic treatment of VRE in stool cultures is discouraged, and may lead to increased transmission by causing diarrhea and emergence of antimicrobial resistance among VRE.
- 3) Treatment of *Candida* isolated from bronchoscopic samples in non-neutropenic patients
  - a. Isolation of *Candida*, even in high concentrations, from respiratory samples of immunocompetent patients, including bronchoscopy, should be interpreted as airway colonization.
  - b. Antifungal therapy should not be initiated unless *Candida* is also isolated from sterile specimens or by histologic evidence in tissue from at-risk patients.
- 4) Use of “double coverage” for gram-negative bacteria
  - a. “Double coverage” of suspected gram-negative infections serves the purpose of providing broad spectrum initial empiric coverage until susceptibility data are known.
  - b. No evidence exists to support the superiority of combination therapy over monotherapy for gram-negative infections once susceptibilities are known.
  - c. Once culture identification and susceptibilities have been reported, de-escalation to a single agent is strongly recommended.
- 5) Use of two agents with anaerobic activity to treat infections with potential anaerobic bacteria involvement
  - a. Double anaerobic coverage is not necessary and puts the patient at risk for additional drug toxicities. No data or guidelines support double anaerobic coverage in clinical practice.
  - b. Example: use of piperacillin/tazobactam + metronidazole.
  - c. Two clinical exceptions are:
    - i. Addition of metronidazole to another agent with anaerobic activity to treat *Clostridioides difficile* infection.
    - ii. Clindamycin added to another agent with anaerobic activity when treating necrotizing fasciitis.

For additional information, refer to the Antimicrobial Stewardship website, <https://asp.mednet.ucla.edu/pages/>