UCLA Health System

Antimicrobial Susceptibility Summary 2019

Clinical Microbiology
Department of Pathology & Laboratory Medicine

Antimicrobial Susceptibility Summary

Clinical Microbiology
Department of Pathology and Laboratory Medicine

UCLA Health System

2019

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

http://www.asp.mednet.ucla.edu/pages/

Select “Antimicrobial Susceptibility Summary” on left side of 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 2018.
Percent Susceptible Data (Tables 1-12)
Emerging Resistance Trends at UCLA (Tables 13-18)

Antimicrobial Testing and Reporting Policies (Tables 27–28)

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 (Table 27) 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:
Brandy Bryant, Dept. of Quality
Diane Citron, R.M. Alden Research Lab
Jennifer Currello, PharmD, Dept. Pharmaceutical Services
Annabelle de St Maurice, MD, Division of Pediatric Infectious Diseases
Meganne S. Kanatani, PharmD, Dept. Pharmaceutical Services
Amy Shayne, Administrative Specialist, Brentwood Annex
Daniel Uslan, MD, Division of Infectious Diseases

Guidelines for Interpretation of Minimal Inhibitory Concentrations (MICs)

MICs are interpreted as susceptible, intermediate, resistant, non-susceptible or susceptible dose dependent according to Clinical and Laboratory Standards Institute (CLSI) 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 (e.g. colistin & *enterobacteriaceae*), an interpretation of wild-type (no resistance genes/mutations) or non-wild-type (with resistance gene or mutation) may be reported. Consultation with Infectious Diseases strongly advised in these cases.

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

Omai B. Garner, Ph.D., D(ABMM), Section Chief, Clinical Microbiology
Shangxin (Shaun) Yang, PhD, D(ABMM), Associate Director, Clinical Microbiology
Cynthia Toy, M.T. (ASCP), Director of Clinical Microbiology
Ruel Mirasol, M.T. (ASCP), Sr. Specialist, Clinical Microbiology
Allison Tsan, CLS, Sr. Specialist, Clinical Microbiology
Alyssa Ziman, M.D., Director of Clinical Laboratories

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

Frequently called numbers*:

Antimicrobial Stewardship Hotline 310-267-7567
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
Infectious Disease Pharmacist (page 92528) 310-267-8510
Microbiology Fellow on-call .... page 90103

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

Table of Contents

Table of Contents

Table.....Page

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

Organism	Location	No. Isolates	Penicillins			Cephalosporins				Carbapenems			Aminoglycosides			Fluoro-quinolone	Other	
			Ampicillin[5]	Ampicillin-sulbactam[5]	Piperacillin-tazobactam	Cefazolin	Cefepime	Ceftazidime	Ceftriaxone[1]	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Trimethoprim – sulfamethoxazole	Colistin[6]
Enterobacter cloacae	OP	107	R[2]	R	92	R	95	—[4]	—	92	99	99	99	96	96	97	91	84
	IP	73	R	R	85	R	90	—	—	89	99	99	99	99	97	97	88	79
	ICU	78	R	R	82	R	94	—	—	90	99	99	99	99	99	91	93	80
Escherichia coli	OP	344	—	—	95	53	85	86	83	98	99	99	99	83	86	70	64	99
	IP	303	—	—	94	44	82	83	79	99	99	99	99	84	83	62	58	99
	ICU	124	—	—	86	34	69	69	66	97	99	99	97	79	76	57	61	99
Klebsiella pneumoniae	OP	157	R	—	89	71	85	83	82	94	94	93	98	88	86	83	78	98
	IP	144	R	—	92	66	87	86	85	96	98	98	98	91	87	84	82	98
	ICU	143	R	—	77	57	83	80	81	94	95	95	96	91	85	77	79	99
Proteus mirabilis	OP	116	—	—	99	3	97	97	90	99	27	99	99	89	91	73	78	R
	IP	49	—	—	98	4	94	98	90	99	31	99	98	85	88	57	67	R
	ICU	38	—	—	97	0	87	95	74	99	26	99	99	79	89	50	50	R
Pseudomonas aeruginosa	OP	516	R	R	79	R	79	80	R	R	75	81	95	86	93	74	R	99
	IP	266	R	R	79	R	82	81	R	R	77	81	95	82	96	78	R	99
	ICU	134	R	R	71	R	76	77	R	R	69	71	93	90	95	79	R	99

OP, outpatient (includes EMC); IP, inpatient (excludes ICU); ICU, intensive care unit

† Calculated from fewer than the standard recommendation of 30 isolates.

[1] Cefotaxime and ceftriaxone have comparable activity against *Enterobacteriaceae*.

[2] R = intrinsic resistance (inherent or innate antimicrobial resistance).

[3] — = Not routinely tested and/or not applicable.

[4] 3rd generation cephalosporins should not be used for serious infections.

[5] Data derived from Jan 1, 2016 to July 26, 2016. Ampicillin and Ampicillin-sulbactam testing were discontinued on July 26, 2016.

[6] There are no clinical breakpoints for Colistin and the Enterobacteriaeceae. These data represent the % of wild-type isolates (below or equal the Epidemiological Cut-off Value or ECV). Wild-type (WT) isolates are those presumed to not have acquired or mutational resistance while the Non-Wild-Type (NWT) isolates are those with acquired or mutational resistance.

[7] For novel antimicrobials (i.e. Ceftolozane-tazobactam and Ceftazidime-avibactam) %S data, please refer to Table 8.

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

Organism	No. Isolates	Penicillins			Cephalosporins				Carbapenems			Aminoglycosides			Fluoro-quinolone	Other	
		Ampicillin[6]	Ampicillin-Sulbactam[6]	Piperacillin-tazobactam	Cefazolin	Cefepime	Ceftazidime	Ceftriaxone[1]	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Trimethoprim–sulfamethoxazole	Colistin[7]
Citrobacter freundii	48	R[2]	R	79	R	92	—[4]	—	96	98	98	99	94	96	88	77	98
Enterobacter aerogenes	90	R	R	88	R	99	—	—	99	98	99	99	99	99	97	99	99
Enterobacter cloacae	259	R	R	87	R	93	—	—	90	99	99	99	98	98	96	91	81
Escherichia coli	774	—	—	94	49	82	83	79	98	99	99	99	83	84	66	63	99
Klebsiella oxytoca	134	R	—	92	15	96	96	92	99	99	99	99	95	97	99	95	99
Klebsiella pneumoniae	430	R	—	87	69	85	84	84	95	96	96	98	90	87	83	80	99
Morganella morganii	64	R	R	98	R	97	—	—	98	—	99	98	81	94	75	69	R
Proteus mirabilis	204	—	—	99	3	95	97	88	99	—	99	99	86	91	66	72	R
Serratia marcescens	128	R	R	96	R	97	—	—	97	84	99	99	99	97	93	97	R
Acinetobacter baumannii	58	R	—	52	R	57	50	—	R	67	67	78	76	78	61	79	93
Pseudomonas aeruginosa	832	R	R	80	R	82	81	R	R	78	82	96	90	95	80	R	99
Stenotrophomonas maltophilia	94	R	R	R	R	—	25	R	R	R	R	R	R	R	—	99	73[9]
Burkholderia cepacia complex	10[5]	R	R	R	R	R	67	R	R	R	78	R	R	R	—	89	R

[1] Cefotaxime and ceftriaxone have comparable activity against *Enterobacteriaceae.*

[2] R = intrinsic resistance.

[3] — = Not routinely tested and/or not applicable.

[4] 3rd generation cephalosporins should not be used for serious infections.

[5] Calculated from fewer than the standard recommendation of 30 isolates.

[6] Data derived from Jan 1, 2016 to July 26, 2016. Ampicillin and Ampicillin-sulbactam testing were discontinued on July 26, 2016.

[7] There are no clinical breakpoints for Colistin and the Enterobacteriaeceae. These data represent the % of wild-type isolates (below or equal the Epidemiological Cut-off Value or ECV). Wild-type (WT) isolates are those presumed to not have acquired or mutational resistance while the Non-Wild-Type (NWT) isolates are those with acquired or mutational resistance.

[8] For novel antimicrobials (i.e. Ceftolozane-tazobactam and Ceftazidime-avibactam) %S data, please refer to Table 8.

[9] Colistin interpreted according to *Pseudomonas aeruginosa* breakpoint.

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

Organism	Source	No. Isolates	Penicillin	Cephalosporins			Carbapenems			Amino-glycosde	Fluoro-quinolone	Other	
			Ampicillin	Oral Cephalosporins[1]	Cefepime	Ceftriaxone[2]	Ertapenem	Imipenem	Meropenem	Gentamicin	Ciprofloxacin	Nitrofurantoin	Trimethoprim – sulfamethoxazole
Enterobacter cloacae	OP	189	R[3]	R	97	—[4,5]	95	99	99	98	97	37	84
	IP	45	R	R	98	—[5]	88	99	99	99	96	39	78
Escherichia coli	OP	7704	57	90	—	93	99	99	99	91	82	96	75
	IP	618	42	76	—	79	99	99	99	84	64	93	66
Klebsiella pneumoniae	OP	1289	R	92	—	92	99	99	99	95	95	31	86
	IP	217	R	80	—	82	94	96	95	87	86	32	77
Proteus mirabilis	OP	642	82	95	—	98	99	—	99	94	85	R	80
	IP	105	79	92	—	98	99	—	99	90	72	R	71
Pseudomonas aeruginosa[6]	OP	321	R	R	92	R	R	85	89	95	81	R	R
	IP	122	R	R	88	R	R	84	89	96	81	R	R

OP, outpatient (includes EMC); IP, inpatient (includes all units and ICUs)

[1] Oral cephalosporins include cefpodoxime and cephalexin for treatment of uncomplicated urinary tract infections.

[2] Cefotaxime and ceftriaxone have comparable activity against *Enterobacteriaceae*

[3] R = intrinsic resistance.

[4] — = Not routinely tested and/or not applicable.

[5] 3rd generation cephalosporins should not be used for serious infections.

[6] Ceftazidime: OP 89%, IP 84%, Piperacillin-tazobactam: OP 85%, IP 80%

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

Organism	Source	No. Isolates	Penicillins			Amino–glycosides	Other										
			Ampicillin	Oxacillin	Penicillin	Gentamicin synergy	Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Quinupristin-dalfopristin	Rifampin [1]	Trimethoprim-sulfamethoxazole	Vancomycin	Ceftaroline
Staphylococcus aureus [2]	All	2639	— [3]	73	<10	—	69	71	99	98	53	99	99	99	99	99	100
Oxacillin-resistant *S. aureus* (MRSA) [2,4]	OP	502	—	R	R	—	19	63	99	97	14	99	99	99	97	99	100
	IP	179	—	R	R	—	13	50	99	96	13	99	99	99	97	99	99
	ICU	89	—	R	R	—	6	56	99	97	10	99	99	97	98	99	100
Oxacillin-susceptible *S. aureus* (MSSA)	OP	1483	—	100	<10	—	88	75	99	98	66	99	99	99	99	99	100
	IP	339	—	100	<10	—	85	75	99	98	68	99	99	99	99	99	100
	ICU	153	—	100	<10	—	92	84	99	99	76	99	99	99	99	99	100
Staphylococcus epidermidis	All	469	—	44	<10	—	51	61	99	89	37	99	99	98	60	99	—
Staphylococcus lugdunensis [10]	All	382	—	97	50	—	97	84	99	99	82	99	99	99	99	99	—
Staphylococcus pseudintermedius / intermedius	All	66	—	71	<10	—	83	54	99	75	52	99	99	99	75	99	—
Coagulase-negative ***Staphylococcus*** [2, 5, 9]	All	169	—	61	<10	—	67	71	99	94	49	99	98	95	80	99	—
Enterococcus spp.[4,6]	All	1008	79	—	—	81	43	R	99	43	R	99	—	23	R	81	R
Enterococcus faecalis [4,7]	All	151	99	—	—	83	50	R	99	40	R	99	R	24	R	97	R
Enterococcus faecium [4,8]	All	89	17	—	—	86	8	R	99	49	R	99	84	6	R	28	R

OP, outpatient (includes EMC); IP, inpatient (excludes ICU); ICU, intensive care unit

[1] Rifampin should not be used as monotherapy.

[2] Staphylococcus resistant to oxacillin are resistant to cefazolin, cephalexin, ceftriaxone and all other beta-lactams except ceftaroline.

[3] — = Not routinely tested and/or not applicable.

[4] Serious Enterococcal infections need combination therapy with Ampicillin, Penicillin, or Vancomycin plus an Aminoglycoside.

[5] *S. saprophyticus* urinary tract infections respond to antibiotic concentrations achieved in urine with agents commonly used to treat acute uncomplicated UTIs

[6] Includes isolates tested from all body sites.

[7] 23% High-level resistance to gentamicin. Includes isolates tested from sterile body sites only.

[8] 15% High-level resistance to gentamicin. Includes isolates tested from sterile body sites only.

[9] Excluding *S. epidermidis*, *S. lugdunensis* and *S. pseudintermedius*.

[10] *S. lugdunensis* is best treated with a Beta-lactam agent.

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
Streptococcus pneumoniae	52	81			—[1]	100	52	89	99	71	—	100
Meningitis [2]		—	92	85	79	—	—	—	—	—	—	—
Non-meningitis [3]		—	62	94	67	—	—	—	—	—	—	—
Viridans group *Streptococcus spp.* [5]	117	—	69 [4]	95	96	—	—	—	—	—	—	100
Streptococcus anginosus	79	—	99	100	100	—	—	—	—	—	—	100
Streptococcus agalactiae (Group B streptococci)	109	—	100	—	—	57	—	—	—	—	—	100
Streptococcus pyogenes (Group A streptococci)	40	—	100	—	—	82	—	78	—	—	65	100

[1] — = Not routinely tested and/or not applicable.

[2] % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients with meningitis.

[3] % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients without meningitis.

[4] Resistant (R) includes **29%** Intermediate (MIC 0.25-2 µg/ml) and **2%** High-level (MIC >2 µg/ml) resistance

[5] Excluding *Streptococcus anginosus*

Table 5. Miscellaneous Gram-negative Bacteria

Organism	No. Isolates	% beta-lactamase positive[1]
Haemophilus influenzae	**137 (pts. >21 y.o)** **51 (pts. ≤21 y.o.)**	**23** **21**
Moraxella catarrhalis	**49 (pts. >21 y.o)** **19 (pts. ≤21 y.o.)**	**96** **100**
Neisseria gonorrhoeae	The current therapy recommendation is ceftriaxone in combination with azithromycin. Culture and susceptibility testing should be performed in cases of treatment failure. See http://www.cdc.gov/std/Gonorrhea/treatment.htm CDC recommends *dual therapy*, or using two drugs, to treat gonorrhea – a single dose of 250mg of intramuscular ceftriaxone AND 1g of oral azithromycin. It is important to take all of the medication prescribed to cure gonorrhea.	
Neisseria meningitidis	*Neisseria meningitidis* remain susceptible to penicillin and ceftriaxone, the drugs of choice for treating meningococcal infections. However, reports (MMWR. 2008. 57:173-175) have noted some isolates with resistance to fluoroquinolones, agents often used for prophylaxis. **Sanford guide 2018** Recommended: Ceftriaxone Alternative: Meropenem, Chloramphenicol	

[1] Resistant to ampicillin, amoxicillin, and penicillin

Table 6. *Pseudomonas aeruginosa*, % Susceptible to One or Two Antimicrobials

Information provided for two drug combination does NOT imply synergism, antagonism or likely activity in vivo; 1358 patients, includes the most resistant result for each drug if patient had >1 isolate

	Amikacin (95)[1]	Gentamicin (89)	Tobramycin (94)	Ciprofloxacin (77)
Cefepime (80)	98[2]	96	98	93
Meropenem (81)	98	96	97	92
Piperacillin-tazobactam (75)	98	96	97	92
Ciprofloxacin (77)	98	96	97	–

*Includes pediatrics and adults

[1] Percent susceptible for individual drug in parenthesis

[2] Percent susceptible for either or both drugs (e.g. %S to amikacin and/or cefepime)

Table 7. *Stenotrophomonas maltophilia*, % Susceptible to One or Two Antimicrobials

Information provided for two drug combination does NOT imply synergism, antagonism or likely activity in vivo; 116 patients, includes pediatrics and adults

	Ceftazidime (27)[1]	Minocycline (100)	Levofloxacin (60)	Trimethoprim-Sulfamethoxazole (100)	Tigecycline (80)	Colistin (51)
Ceftazidime (27)	—	98[2]	72	100	85	66
Minocycline (100)	98	—	99	100	—	98
Levofloxacin (60)	72	99	—	100	83	81
Trimethoprim-Sulfamethoxazole (100)	100	100	100	—	100	100
Tigecycline (80)	85	—	83	100	—	89
Colistin (51)	66	98	81	100	89	—

* Colistin interpreted according to *Pseudomonas* breakpoint. Tigecycline by ≤2 ug/mL.

† Includes pediatrics and adults.

[1] Percent susceptible for individual drug in parenthesis

[2] Percent susceptible for either or both drugs (e.g. %S to ceftazidime and/or minocycline)

Table 8. Most Resistant Gram-negative Bacteria – Non-Urine Isolates, %Susceptible

Organism	No Isolates	Amikacin	Tigecycline	Colistin[1]	Ceftolozane-Tazobactam[2]	Ceftazidime-Avibactam[2]
Carbapenem Resistant Enterobacteriaceae (CRE)	**105**	**86**	**ND**	**51**	**45**	**95**

Organism	No isolates	Amikacin	Ciprofloxacin	Piperacillin-Tazobactam	Cefepime	Ceftazidime	Ceftaolozane-Tazobactam[2]	Ceftazidime-Avibactam[2]	Colistin
Pseudomonas aeruginosa **(Imipenem or Meropenem resistant)**	**210**	**87**	**43**	**41**	**47**	**48**	**83**	**83**	**90**
Pseudomonas aeruginosa **(Imipenem and Meropenem resistant)**	**160**	**84**	**38**	**27**	**36**	**36**	**79**	**79**	**98**

* Include pediatrics and adults.

[1] There are no clinical breakpoints for Colistin and the Enterobacteriaeceae. These data represent the % of wild-type isolates (below or equal the Epidemiological Cut-off Value or ECV). Wild-type (WT) isolates are those presumed to not have acquired or mutational resistance while Non-Wild-type (NWT) isolates are those with acquired or mutational resistance.

[2] Restricted formulary ID consult required. Ceftolozane-tazobactam and Ceftazidime-avibactam interpretation are based on CLSI breakpoints.

Table 9. Pediatrics (≤21 y.o.) Gram-negative Bacteria - Non-Urine Isoaltes % Susceptible

Organism	No. Isolates	Penicillins			Cephalosporins				Carbapenems			Aminoglycosides			Fluoroquinolon	Other
		Ampicillin	Ampicillin-sulbactam	Piperacillin-tazobactam	Cefazolin	Cefepime	Ceftazidime	Ceftriaxone[1]	Ertafenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin[2]	Trimethoprim – sulfamethoxazole
Enterobacter cloacae	38	R[4]	R	89	R	92	—[5]	—[5]	92	99	99	99	97	95	95	92
Escherichia coli	73	—	—	97	86	93	96	89	99	99	99	99	96	89	82	63
Klebsiella pneumoniae	35	R	—	94	91	94	94	94	99	99	99	99	97	97	91	89
Serratia marcescens	17[3]	R	R	99	R	99	—[5]	—[5]	94	71	99	99	99	94	94	99
Pseudomonas aeruginosa	93	R	R	89	R	93	90	R	R	85	91	97	95	95	87	R

[1] Cefotaxime and ceftriaxone have comparable activity against *Enterobacteriaceae* .

[2] Ciprofloxacin is associated with arthropathy and histological changes in weight-bearing joints of juvenile animals and is currently not FDA approved for pediatric use.

[3] Calculated from fewer than the standard recommendation of 30 isolates.

[4] R = intrinsic resistance (inherent or innate antimicrobial resistance).

[5] 3rd generation cephalosporins should not be used for serious infections.

* Ampicillin and Ampicillin-sulbactam testing were discontinued on July 26, 2016.

Table 10. Pediatrics (≤ 21 y.o.) Gram-negative Bacteria - Urine Isolates, % Susceptible

Organism	No. Isolates	Penicillins		Cephalosporins				Carbapenems			Aminoglycosides			Fluoroquinolone	Other	
		Ampicillin	Ampicillin-sulbactam	Oral Cephalosporins [1]	Cefepime	Ceftazidime	Ceftriaxone [2]	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin [3]	Trimethoprim – sulfamethoxazole	Nitrofurantoin
Enterobacter cloacae	32	R[4]	R	R	97	—[5]	—	94	99	99	99	97	—	94	77	62
Escherichia coli	963	59	63	92	—	—	95	99	99	99	99	93	—	91	76	98
Klebsiella pneumoniae	81	R	86	98	—	—	99	99	99	99	99	99	—	99	96	37
Proteus mirabilis	80	87	93	98	—	—	99	99	ND	99	99	94	—	98	88	R
Pseudomonas aeruginosa	23†	R	R	R	91	83	R	R	96	96	99	99	99	99	R	R

[1] Oral Cephalosporins include Cefpodoxime and Cephalexin for treatment of uncomplicated urinary tract infections.

[2] Ceftriaxone and Cefotaxime have comparable activity against *Enterobacteriaceae.*

[3] Ciprofloxacin is associated with arthropathy and histological changes in weight-bearing joints of juvenile animals and is not FDA approved for pediatric use.

[4] R Intrinsic resistance (inherent or innate antimicrobial resistance).

— Not routinely tested and/or not applicable.

† Calculated from fewer than the standard recommendation of 30 isolates.

For novel antimicrobials (i.e. Ceftolozane-tazobactam and Ceftazidime-avibactam) %S data, please refer to Table 8.

Table 11. Pediatrics (≤ 21 y.o.) Gram-positive Cocci, % Susceptible

Organism	Location	No. Isolates	Penicillins			Cephalos-porins		Amino-glycosides	Others										
			Ampicillin	Oxacillin	Penicillin	Ceftriaxone	Cefotaxime	Gentamicin synergy	Ciprofloxacin [1]	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Quinupristin-dalfopristin	Rifampin [2]	Trimethoprim-sulfamethoxazole	Vancomycin	Ceftaroline
Staphylococcus aureus **(All)** [3]	OP	411	—[4]	81	<10	—	—	—	76	77	99	99	56	99	99	99	99	99	100
	IP	113	—	80	<10	—	—	—	80	80	99	99	66	99	99	97	99	99	100
Oxacillin-resistant ***S. aureus*** **(MRSA)** [3]	OP	83	—	R[5]	R	R	R	—	32	78	99	99	21	99	99	99	99	99	100
	IP	23†	—	R	R	R	R	—	22	65	99	99	26	99	99	91	99	99	100
Oxacillin-susceptible ***S. aureus*** **(MSSA)**	OP	333	—	100	<10	—	—	—	87	76	99	99	63	99	99	99	99	99	100
	IP	91	—	100	<10	—	—	—	96	84	99	99	76	99	99	99	99	99	100
Coagulase negative ***Staphylococcus*** [6] ***(sterile body sites)***	All	23†	—	59	<10	—	—	—	83	70	99	91	30	99	99	96	74	99	—
	OP	7†	—	67	<10	—	—	—	86	71	99	99	57	99	99	99	86	99	—
	IP	16†	—	56	<10	—	—	—	81	69	99	88	19	99	99	94	69	99	—
Staphylococcus epidermidis	All	72	—	35	<10	—	—	—	72	43	99	88	19	99	99	96	71	99	—
Staphylococcus lugdunensis	All	36	—	94	<10	—	—	—	99	94	99	99	94	99	99	99	99	99	—
Enterococcus **spp.**[7]	All	72	89	—	—	R	R	85	57	R	99	38	R	99	—	24	R	90	—
Enterococcus faecalis [8]	All	15†	99	—	—	R	R	79	83	R	99	33	R	99	R	20	R	99	—
Enterococcus faecium [8]	All	7†	29	—	—	R	R	99	0	R	100	57	R	99	99	0	R	29	—

OP, outpatient (includes EMC); IP, inpatient (includes ICU)

† Calculated from fewer than the standard recommendation of 30 isolates.

[1] Ciprofloxacin is associated with arthropathy and histological changes in weight bearing joints of juvenile animals and is not FDA approved for pediatric use.

[2] Rifampin should not be used as monotherapy.

[3] *Staphylococcus* resistant to oxacillin are resistant to cefazolin, cephalexin, ceftriaxone and all other beta-lactams except ceftaroline.

[4] — = Not routinely tested and/or not applicable.

[5] R = intrinsic resistance

[6] Excludes *S.epidermidis* and *S.lugdunensis*

[7] Includes isolates tested from all body sites.

[8] Sterile Sites: **13%** High-level resistance to gentamicin. Includes isolates tested from sterile body sites only.

Table 11. Pediatrics (≤ 21 y.o.) Gram Positive Cocci, % Susceptible (cont)

Organism	No. Isolates	Penicillins		Cephalosporins		Other				
		Amoxicillin	Penicillin	Cefotaxime	Ceftriaxone	Clindamycin	Doxycycline	Erythromycin	Trimethoprim – sulfamethoxazole	Vancomycin
Viridans group Streptococcus Sterile body sites	21†	—	60	95	95	—	—	—	—	100
Streptococcus anginosus	9†	—	89	100	89	—	—	—	—	100
Streptococcus pneumoniae	8†	100		—	—	88	100	88	88	100
Meningitis[1]		—	88	88	88	—	—	—	—	—
Non-meningitis[2]		—	100	100	100	—	—	—	—	—

† Calculated from fewer than the standard recommendation of 30 isolates

– Not routinely tested and/or not applicable.

[1] % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients with meningitis.

[2] % susceptible for penicillin, cefotaxime and ceftriaxone applies to patients without meningitis.

Table 12. Yeasts, %S, %I, %SDD, %R, 2016-2018

1. Breakpoints are based on CLSI standards (M27 4th Ed and M60 1st Ed). Breakpoints shown in shaded rows.
2. When antifungal therapy is necessary, most yeast infections can be treated empirically. Antifungal testing of yeasts may be warranted for the following:
   - Oropharyngeal 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.
3. Yeast isolates from sterile body sites are tested every 7 days; isolates from other sources are tested upon special request.
4. Isolation of Candida in respiratory specimens of immunocompetent patients should be interpreted as airway colonization.

		Percent Susceptible, Susceptible Dose Dependent, Intermediate, Resistant at Breakpoints [1]											
Organism	**No. of Isolates**	**Fluconazole**			**Voriconazole**			**Caspofungin**			**Anidulafungin**		
C.albicans	**420**	≤ 2 S	4 SDD	≥ 8 R	≤ 0.12 S	0.25-0.5 I	≥ 1 R	≤ 0.25 S	0.5 I	≥ 1 R	≤ 0.25 S	0.5 I	≥ 1 R
		85	**8**	**7**	**87**	**11**	**2**	**98**	**1**	**1**	**99**	**1**	**0**
C.glabrata	**323**	—	≤32 SDD	≥ 64 R	—	—	—	≤ 0.12 S	0.25 I	≥ 0.5 R	≤ 0.12 S	0.25 I	≥ 0.5 R
		—	**82**	**18**	—#	—#	—#	**92**	**5**	**3**	**97**	**1**	**2**
C.parapsilosis	**123**	≤ 2 S	4 SDD	≥ 8 R	≤ 0.12 S	0.25-0.5 I	≥ 1 R	≤ 2 S	4 I	≥ 8 R	≤ 2 S	4 I	≥ 8 R
		90	**3**	**7**	**93**	**2**	**5**	**100**	**0**	**0**	**100**	**0**	**0**
C.tropicalis	**72**	≤ 2 S	4 SDD	≥ 8 R	≤ 0.12 S	0.25-0.5 I	≥ 1 R	≤ 0.25 S	0.5 I	≥ 1 R	≤ 0.25 S	0.5 I	≥ 1 R
		88	**4**	**8**	**87**	**13**	**0**	**96**	**0**	**4**	**99**	**1**	**0**
C.krusei	**42**	—	—	—	≤ 0.5 S	1 I	≥ 2 R	≤ 0.25 S	0.5 I	≥ 1 R	≤ 0.25 S	0.5 I	≥ 1 R
		R‡	**R‡**	**R‡**	**83**	**12**	**5**	**90**	**10**	**0**	**100**	**0**	**0**
C.guilliermondii	**13†**	—	—	—	—	—	—	≤ 2 S	4 I	≥ 8 R	≤ 2 S	4 I	≥ 8 R
		—	—	—	—	—	—	**100**	**0**	**0**	**92**	**8**	**0**

[1] S = Susceptible; I = Intermediate; SDD = Susceptible dose dependent, susceptibility dependent on achieving maximal possible blood level; R = Resistant

[2] Not all isolates were tested against all four antifungal agents.

— Not routinely tested and/or not applicable (ie. no clinical breakpoints for this organism/drug combination testing)

† Calculated from fewer than the standard recommendation of 30 isolates

For *C.glabarata* and Voriconazole, current data are insufficient to demonstrate correlation between *in –vitro* susceptibility testing and clinical outcome.

‡ *C. krusei* are assumed to be intrinsically resistant to Fluconazole.

Table 13. 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
Staphylococcus aureus	oxacillin (MRSA)	Adults (>21 y.o.) Inpatients (n=724) 35% Outpatients (n=1980) 25% Pediatrics (<21 y.o.) Inpatients (n=113) 20% Outpatients (n=411) 20%	vancomycin ceftaroline daptomycin	MRSA are clinically resistant to all ß-lactams, ß-lactam / ß-lactamase inhibitor combinations and carbapenems, excluding ceftaroline.[1] MRSA are also typically resistant to fluoroquinolones
Streptococcus pneumoniae (non-meningitis)	penicillin (MIC > 2 µg/ml)	All isolates (n = 60) 10%	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.[1]
Streptococcus pneumoniae (non-meningitis)	cefotaxime, ceftriaxone (penicillin resistant always)	All isolates (n=60) Low level R 5% High level R 2%	vancomycin levofloxacin	If low-level resistance (MIC=2.0 µg/ml), high dose cefotaxime or ceftriaxone may be effective for infections other than meningitis.[1]

Table 13. 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 *Streptococcus*	penicillin	Blood isolates (n = 73) low level R 26% high level R 3%	vancomycin or penicillin + aminoglycoside	Level of penicillin resistance is particularly useful in guiding therapy for endocarditis.[1] For low level resistance, MICs are 0.25–2.0 µg/ml; for high level, MICs are >2.0 µg/ml.[2]
Enterococcus spp.	vancomycin (VRE)	Blood isolates *E. faecium* (n = 70) 74% *E. faecalis* (n = 76) 5%	Check in vitro susceptibility results and contact Infectious Diseases.	Vancomycin-resistant *Enterococcus* (VRE) are often resistant to many potentially useful agents. Therapeutic management must be determined on a case-by-case basis.
	gentamicin synergy screen (GENT)	Blood isolates *E. faecium* (n = 70) 14% *E. faecalis* (n = 76) 18%	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.

Table 13. Emerging Resistance Concerns (cont.)

Organism	Resistant to:	Percent Resistant:	Therapeutic Options	Comments
Klebsiella spp. *E. coli*	ceftriaxone or other 3rd generation cephalosporin	Blood isolates: *Klebsiella* spp. (n = 155) 15% *E. coli* (n =307) 21%	ertapenem ciprofloxacin	In vitro resistance to 3rd generation cephalosporins suggests the strain is producing extended-spectrum ß-lactamases (ESBL), or AmpC
K. pneumoniae and other *Enterobacteriaceae*	carbapenem	All isolates: <1%	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.
Citrobacter freundii *Enterobacter* spp. *Providencia* spp. *Proteus* spp. (except *P. mirabilis*) *Serratia marcescens*	3rd generation cephalosporins (e.g. ceftriaxone)	See comments	aminoglycoside ciprofloxacin ertapenem meropenem trimeth-sulfa	Organisms listed typically produce inducible ß-lactamases. Isolates that appear susceptible to 3rd generation cephalosporins may develop resistance during therapy.[1]
Pseudomonas aeruginosa	cefepime and/or piperacillin-tazobactam	All isolates: (n=1358) 15%	Check in vitro susceptibility results and contact Infectious Diseases.	Combination therapy with a beta-lactam plus ciprofloxacin or an aminoglycoside (with susceptible results in vitro) should be considered. Therapeutic management must be determined on a case by case basis.
Acinetobacter baumannii	amikacin, cefepime, ceftazidime, ciprofloxacin, meropenem, piperacillin-tazobactam, trimethoprim-sulfa	All isolates: (n=101) 16%	Check in vitro susceptibility results and contact Infectious Diseases.	Therapeutic management must be determined on a case by case basis.

Table 13. Emerging Resistance Concerns (cont.)

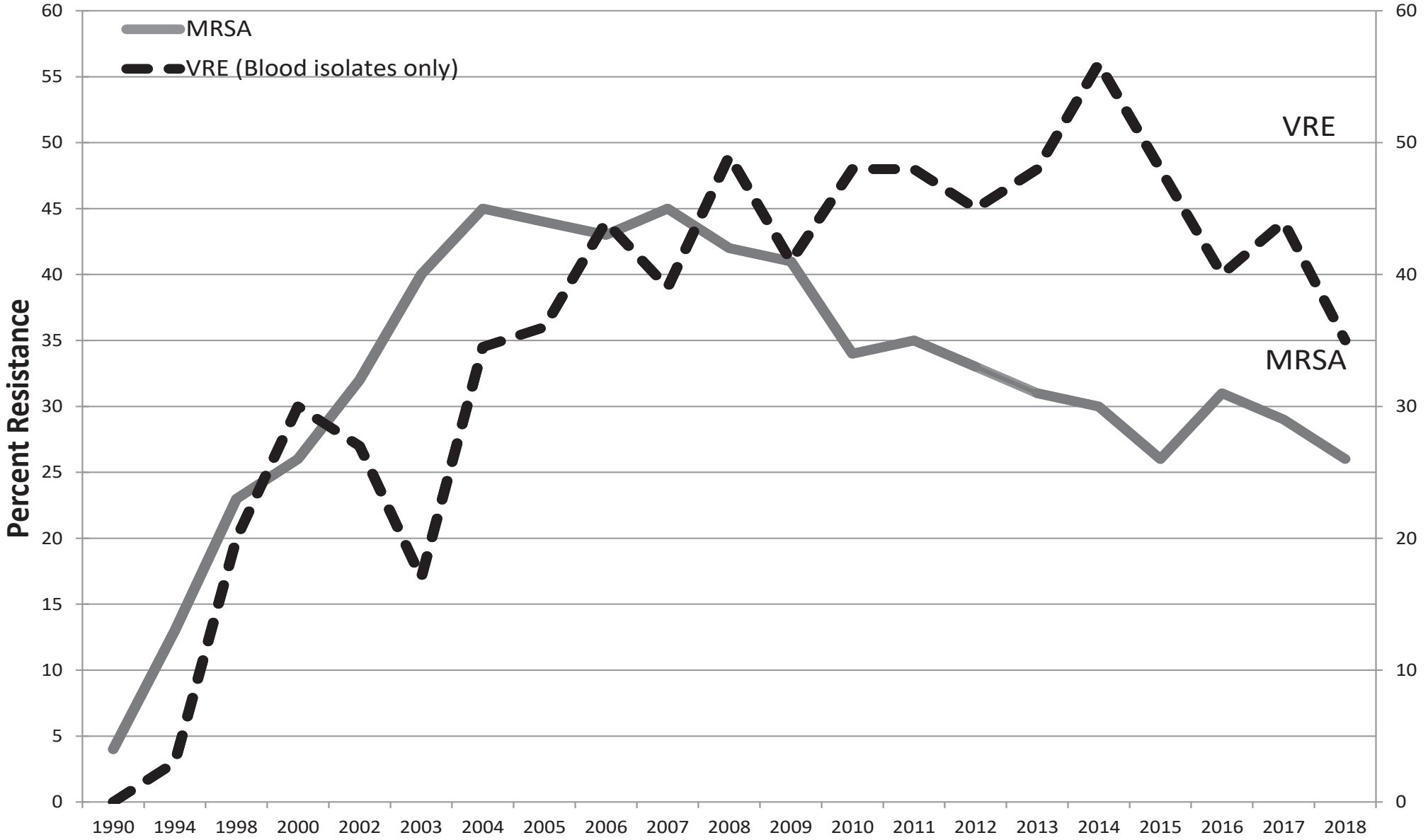
When specific antimicrobial resistance (R) is detected, an Infectious Disease (ID) consult is strongly suggested.

Organism	If Resistant to:	Therapeutic Options	Comments
Candida krusei	caspofungin	voriconazole[3] amphotericin[4]	Typically susceptible to caspofungin. Breakthrough infections have been reported.[5]
	voriconazole	caspofungin[6] amphotericin[4, 7]	Intrinsically resistant to fluconazole.[8, 9] Typically susceptible to voriconazole.[8, 9]
Candida glabrata	caspofungin	fluconazole[10] voriconazole[3] amphotericin[4, 7]	Caspofungin resistance may be emerging.[8]
	fluconazole	voriconazole[3] caspofungin[6] amphotericin[4, 7]	Typically resistant to fluconazole.[8, 9]
Candida albicans	caspofungin	fluconazole[10] amphotericin[4, 7]	Typically susceptible to caspofungin.[8, 9]
	fluconazole	caspofungin[6] amphotericin[4, 7]	Typically susceptible to fluconazole but resistance can develop during therapy.[8, 9]
Candida auris	Often resistant to azoles, amphotericin and some are echinocandin resistant	Infectious Disease consult is strongly suggested	*Candida auris* is an emerging multi-drug resistant organism, able to cause wide range of infections.[1]

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.

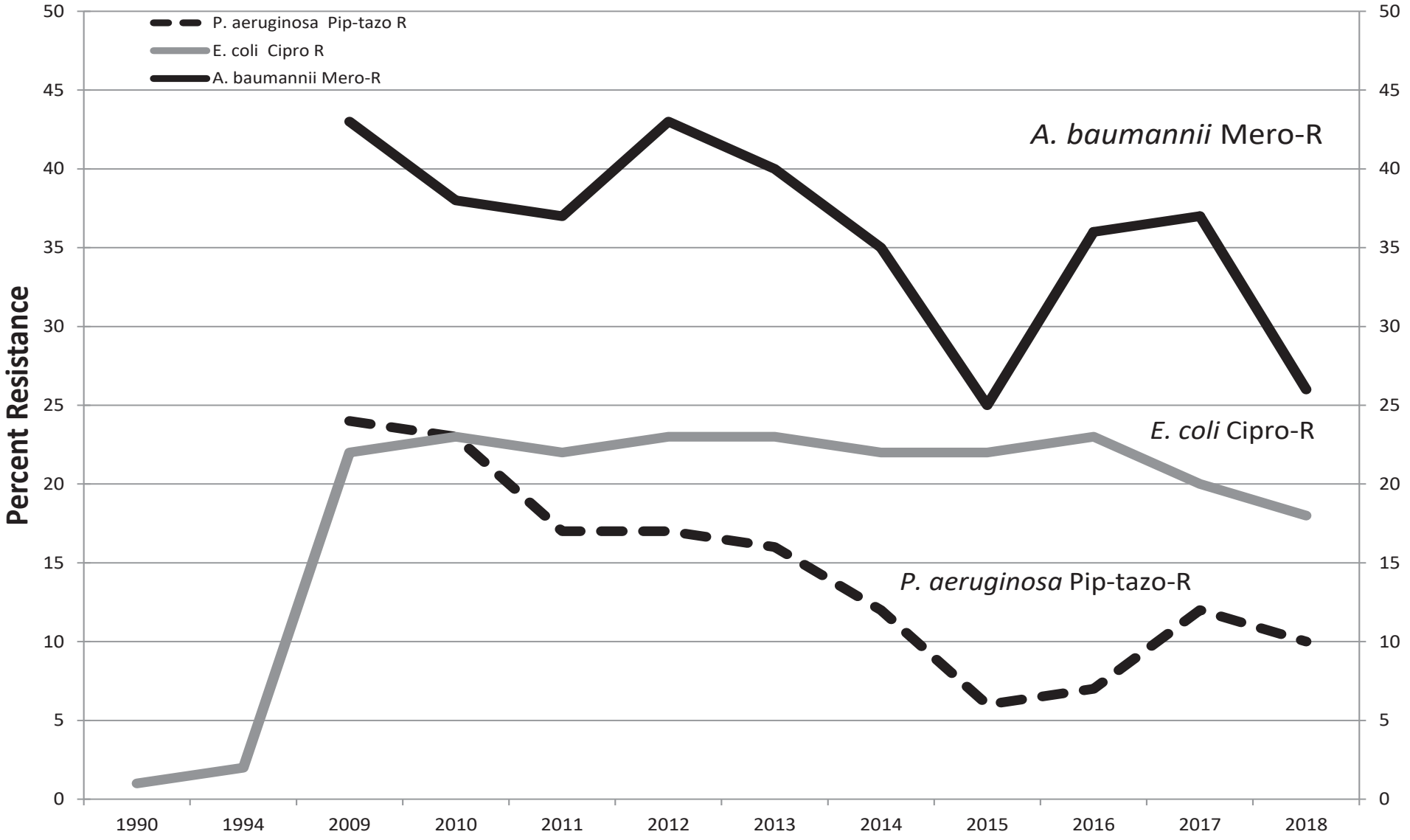
1 The Sanford Guide. 2018
2 Circulation. 2015;132:1435-1486
3 Voriconazole has poor penetration in urine.
4 Amphotericin has poor penetration in urine.
5 Bone Marrow Transplantation. 2015;50:158-160.
6 Caspofungin may not reach therapeutic concentration in the CSF, vitreous fluid or urine.
7 Among patients without baseline renal dysfunction and suspected azole- and echinocandin-resistant *Candida* infections, liposomal amphotericin B is recommended. Infectious Disease consult is highly recommended.
8 Clin. Infect. Dis. 2016;62(4):e1-e50
9 Treatment Guidelines from the Med. Letter-Antifungal Drugs. 2012;10(120);61-68
10 For initial treatment with fluconazole, careful consideration should be given, especially in critically ill patients or those with prior azole exposure or prophylaxis. Infections Disease consult is highly recommended.

Table 14. Resistance Trends: 1990-2018



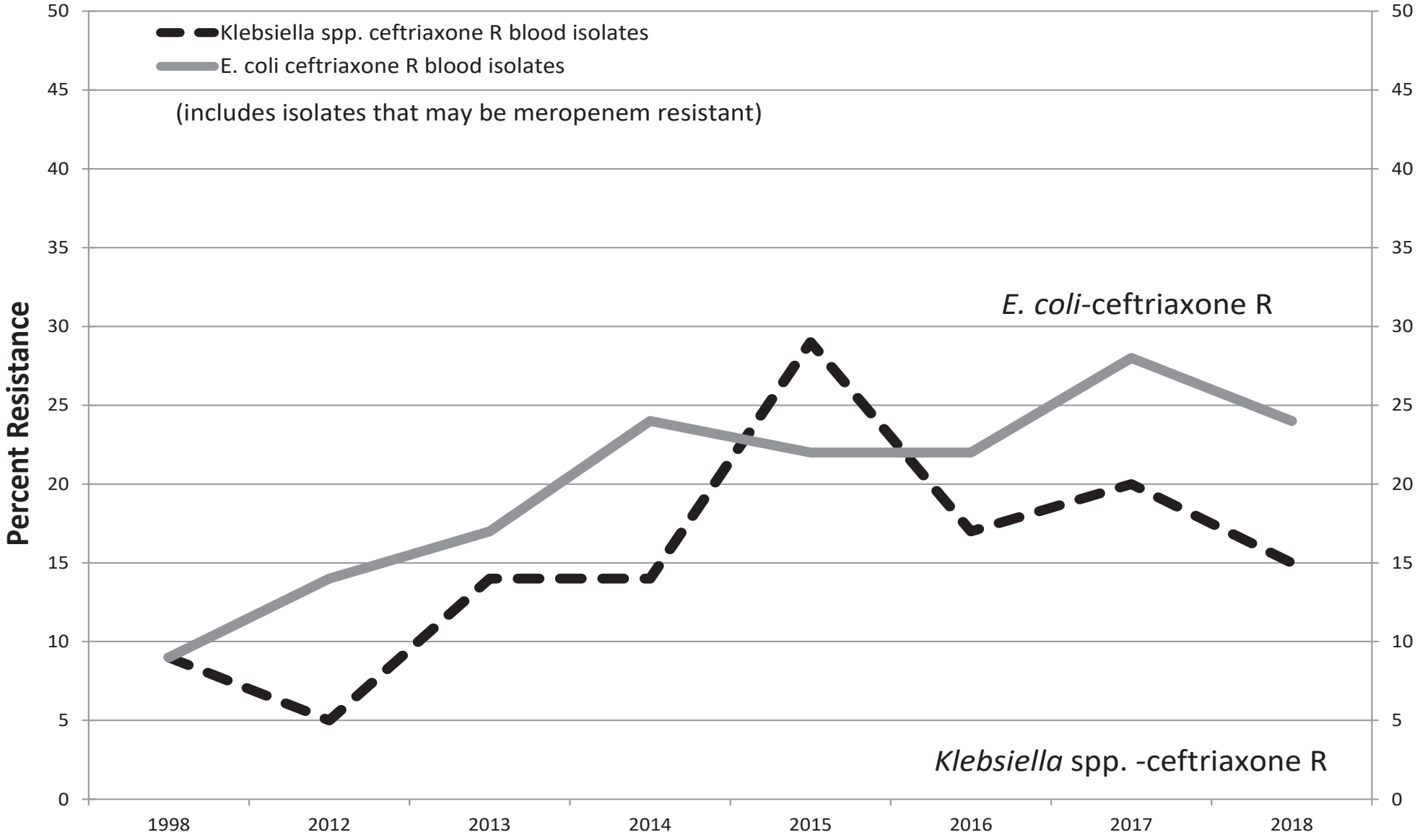
NOTE:
1990-2015: Derived from RRH data
2016-2018: Combined data from RRH and SMH

Table 14. Resistance Trends: 1990-2018 (cont.)



NOTE:
1990-2015: Derived from RRH data
2016-2017: Combined data from RRH and SMH

Table 14. Resistance Trends: 1990-2018 (cont.)

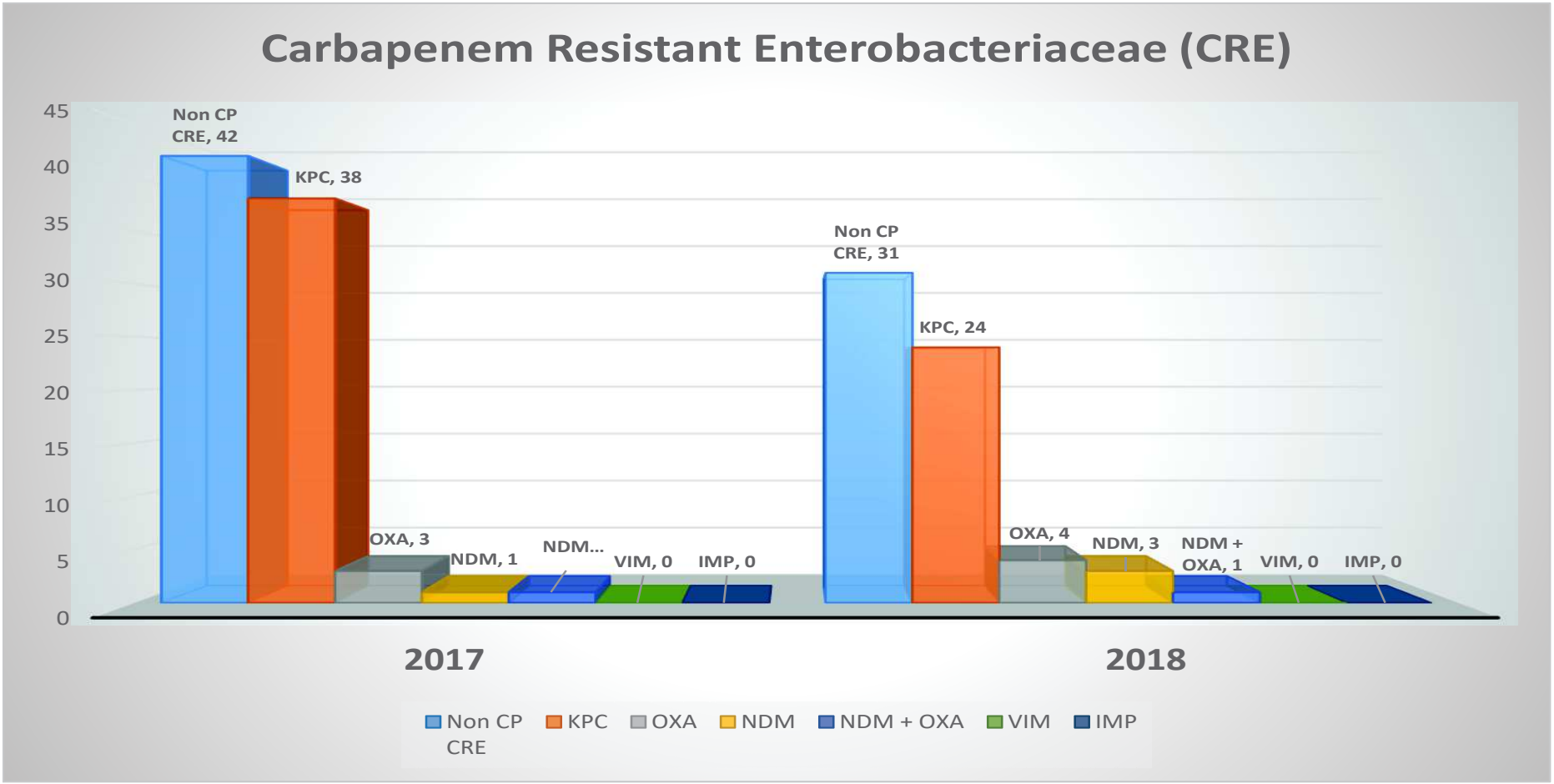


Note: No data prior to 1998
1998-2015: Derived from RRH data
2016-2017: Combined data from RRH and SMH

Table 15. Carbapenem-resistant *Enterobacteriaceae* (CRE): 2009-2018

CRE Distributions by Year

Year	Non CP CRE	CP-CRE					
		KPC	OXA	NDM	NDM + OXA	VIM	IMP
2017	42	38	3	1	1	0	0
2018	31	24	4	3	1	0	0



CP CRE: Carbapenemase Producing CRE

Non-CP CRE: Non-Carbapenemase Producing CRE

Table 16. Treatment Suggestions for Organisms for which Susceptibility Testing is not Routinely Performed

Organism	Recommended	Alternate treatment	Comments / Also Effective
Bordetella pertussis [1]	Azithromycin or Clarithromycin	Trimethoprim-sulfamethoxazole	
Campylobacter jejuni [1]	Azithromycin	Consult with ID	Trimethoprim-sulfamethoxazole, Penicillin & Cephalosporins **NOT Active**
Campylobacter fetus [1]	Gentamicin	Imipenem or Ceftriaxone	Ampicillin
Legionella spp. [1]	Levofloxacin or Moxifloxacin	Azithromycin	
Mycoplasma pneumoniae [1]	Doxycycline	Azithromycin, Minocycline	Clindamycin & B-lactams **NOT Effective**. Increasing macrolide resistance.
Mycoplasma hominis	Consult with ID	Clindamycin, Fluoroquinolone (if in vitro susceptibilty)	Resistant to Erythromycin and azithromycin. Fluoroquinolone and Tetracycline resistant strains have been reported. (*CMR 2005, 18:757-789)* [3] *(AAC 2004, 58:176)* [4]
Stenotrophomonas maltophilia [1, 2]	Trimethoprim-sulfamethoxazole	Minocycline (if in vitro susceptibility) (*Case reports JAC 2016; 71:1701)* [5]	Fluroquinolone See Table 7 Combination agent (if in vitro susceptibility) *(AAC 2004, 58:176)* [4]
Cutibacterium (Propionibacterium) acn	Penicillin, Ceftriaxone	Vancomycin, Daptomycin, Linezolid	Resistant to Metronidozole
Ureaplasma	Azithromycin, Doxycycline		Resistant to Clindamycin. Tetracycline resistant strains have been reported. *(Case reports CMR 2005, 18:757-789)* [3]

The Sanford Guide to Antimicrobial Theraphy 2015, 45th Edition

*For additional information, refer to the Antimicrobial Stewardship website, www.asp.mednet.ucla.edu

[1] Based on The Sanford Guide to Antimicrobial Therapy 2018 48th edition.

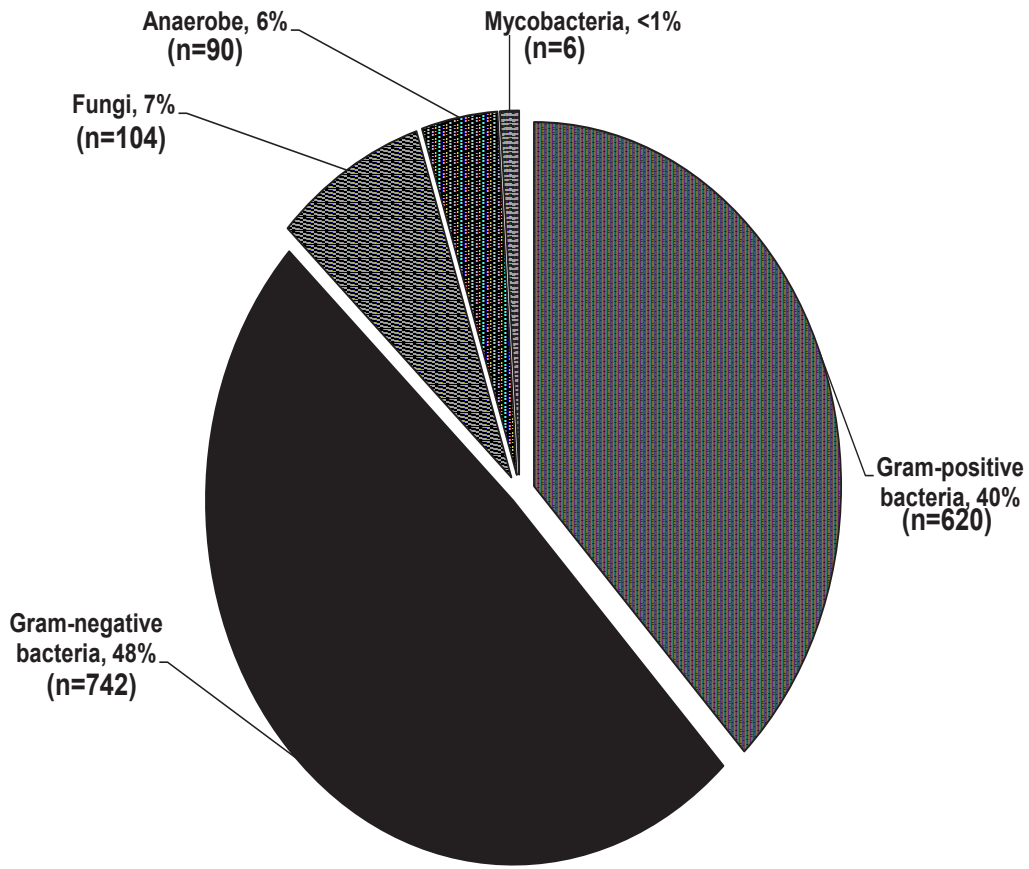
[2] Susceptibility performed on Stenotrophomonas maltophilia isolates from Sterile body sites and Cystic Fibrosis cases.

[3] CMR - Clinical Microbiology Review

[4] AAC - Antimicrobial Agents & Chemotherapy Journal

[5] JAC - Journal of Antimicrobial Chemotherapy

Table 17. Blood: One Isolate per Patient, 2018



	Organism	n	% of Total Blood Isolates
1	*Escherichia coli*, 23% ceftriaxone R	304	
2	*Staphylococcus aureus*, 29% MRSA	176	
3	*Enterococcus* spp., 39% VRE	163	
4	*Klebsiella* spp., 17% ceftriaxone R	141	
5	Other *Enterobacteriaceae* spp.	83	
6	Viridans group *Streptococcus*	114	
7	*Pseudomonas aeruginosa*	61	
8	*Candida glabrata*	42	
9	*Enterobacter cloacae*	48	
10	B-hemolytic *Streptococci* (Groups A, B, C & G)	61	
11	*Candida albicans*	35	
12	*Proteus mirabilis*	32	
13	*Bacteroides* spp.	38	
14	*Serratia marcescens*	10	
15	*Acinetobacter* spp.	18	
	Total blood isolates	**1326***	

*Excludes Coagulase-negative *Staphylococcus* (n=578)
Corynebacterium spp. (n=48)
Bacillus spp. (n=16)
Micrococcus spp. (n=8)
Propionibacterium acnes (n=2)

Table 17. Blood: One Isolate per Patient, 2018 (cont.)

Gram-positive Bacterial Isolates	n	% of Gram-positive Isolates
Staphylococcus aureus, 29% MRSA	176	28
Enterococcus spp., 39% VRE	163	26
Viridans group *Streptococcus*	114	18
Beta-hemolytic *Streptococcus*	61	10
Other gram-positives (includes 5 *S. lugdunensis*)	48	8
Streptococcus pneumoniae	17	3
Granulicatella spp.	12	2
Lactobacillus species	12	2
Gemella species	10	2
Abiotrophia spp.	8	1
Total	**620**	

(excludes other coagulase –negative staphylococcus, *Corynebacterium* spp., *Bacillus* spp., *Micrococcus* spp.)

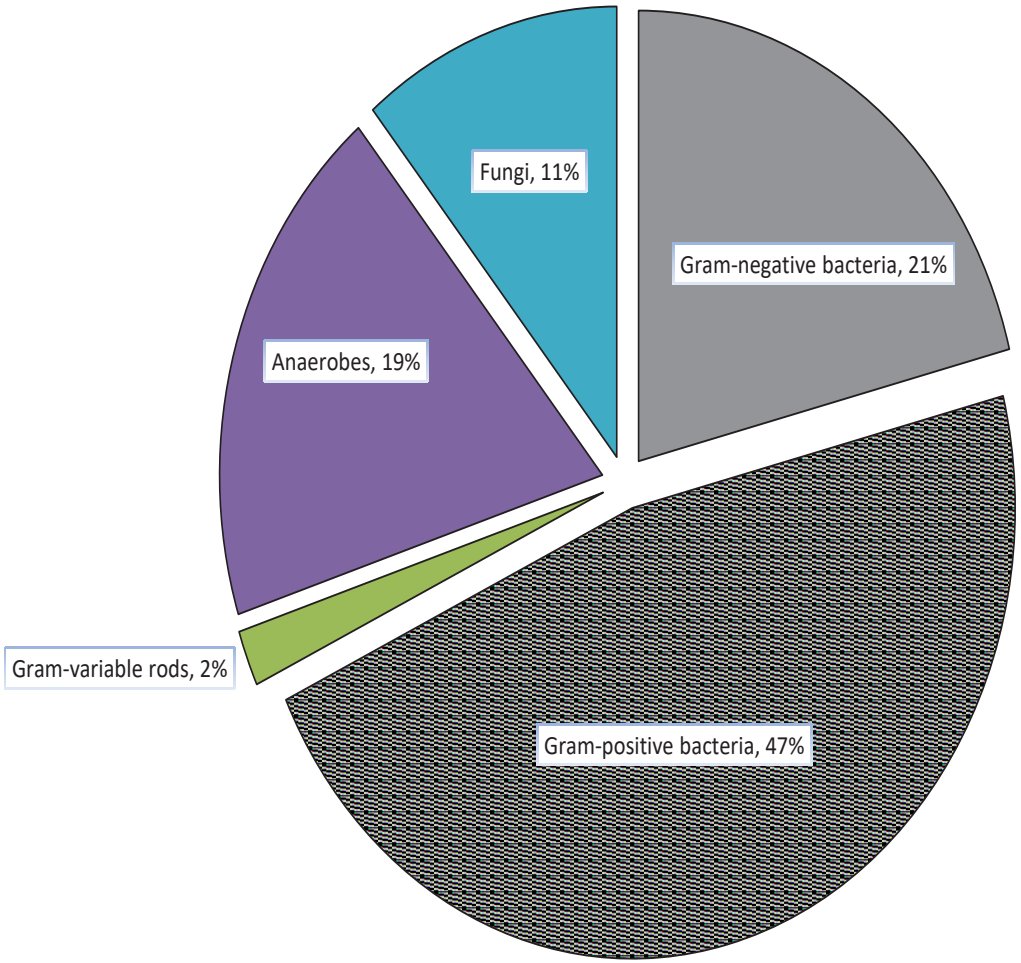
Gram-negative Bacterial Isolates	n	% of Gram-negative Isolates
Escherichia coli, 23% ceftriaxone R	304	41
Klebsiella spp., 17% ceftriaxone R	156	21
Pseudomonas aeruginosa	61	8
Enterobacter cloacae	48	6
Other *Enterobacteriaceae* spp.	43	6
Other gram-negatives	41	6
Proteus mirabilis	32	4
Acinetobacter spp.	18	2
Stenotrophomonas maltophilia	15	2
Citrobacter spp.	14	2
Serratia marcescens	10	1
Total	**742**	

Fungal Isolates	n	% of Fungal Isolates
Candida albicans	35	34
Candida glabrata	31	30
Candida parapsilosis	13	13
Candida tropicalis	7	7
Other yeast	5	5
Candida krusei	4	4
Candida lusitaniae	3	3
Candida dubliniensis	2	2
Cryptococcus neoformans	1	1
Candida guilliermondii	1	1
Rhodotorula spp.	1	1
Trichosporon asahii	1	1
Total	**104**	

Anaerobic Bacterial Isolates	n	% of Anaerobic Bacterial Isolates
Bacteroides spp.	38	42
Clostridium spp.	13	14
Other anaerobes	17	19
Fusobacterium spp.	7	8
Prevotella spp.	5	6
Parvimonas micra	4	4
Eubacterium spp.	2	2
Eggerthella lenta	2	2
Veillonella Spp.	1	1
Finegoldia magna	1	1
Total	**90**	

Mycobacterial Isolates	n	% of Mycobacterial Isolates
Mycobacterium abscessus	1	17
Mycobacterium avium complex	1	17
Mycobacterium canariasense	1	16
Mycobacterium chelonae	1	17
Mycobacterium fortuitum group	1	17
Mycobacterium obuense	1	16
Total	**6**	

Table 18. CSF: One Isolate per Patient, 2018



n = 33	Number of CSF Isolates
Gram-positive bacteria (29)	
• *Staphylococcus epidermidis*	13
• *Staphylococcus aureus*	4
• *Staphylococcus capitis*	2
• *Staphylococcus hominis*	2
• *Staphylococcus haemolyticus*	1
• *Staphylococcus cohnii*	1
• *Abiotrophia defectiva*	1
• Viridans group *Streptococcus*	1
• *Enterococcus faecalis*	1
• *Enterococcus avium*	1
• *Listeria monocytogenes*	1
• *Paenibacillus species*	1
Gram-negative bacteria (13)	
• *Pseudomonas aeruginosa*	3
• *Escherichia coli*	2
• *Acinetobacter baumannii*	1
• *Enterobacter (Klebsiella) aerogenes*	1
• *Enterobacter cloacae complex*	1
• *Haemophilus influenzae*	1
• *Neisseria species, not meningitidis*	1
• *Pantoea species*	1
• *Pseudomonas putida*	1
• *Serratia marcescens*	1
Gram-variable bacteria (1)	1
Fungi (7)	
• *Coccidioides immitis*	2
• *Cryptococcus neoformans*	2
• *Cryptococcus gattii*	2
• *Candida parapsilosis*	1
Anaerobic bacteria (12)	
• *Propionibacterium (Cutibacterium) acnes*	11
• *Propionibacterium avidum*	1

Table 19. Mycobacteria, One Isolate per Patient per Source, 2018

Organisms	No of Isolates	# Patients By Source[1]		
		Respiratory	Abscess/ wound/ tissue/other	Blood
Mycobacterium avium complex	209	182	26	1
Mycobacterium mucogenicum	38	38		
Mycobacterium abscessus	37	30	7	
Mycobacterium chelonae	33	16	17	
Mycobacterium fortuitum / *Mycobacterium fortuitum* group	30	17	12	1
Mycobacterium tuberculosis / *Mycobacterium tuberculosis* complex	18	12	6	
Mycobacterium gordonae	18	16	2	
Mycobacterium phocaicum	6	6		
Mycobacterium immunogenum	6	1	5	
Mycobacterium not *tuberculosis*	4	4		
Mycobacterium porcinum	3	3		
Mycobacterium lentiflavum	2	2		
Mycobacterium simiae	2	1	1	
Mycobacterium kansasii	1	1		
Mycobacterium arupense	1	1		
Mycobacterium neoaurum	1	1		
Mycobacterium smegmatis	1		1	
Mycobacterium canariasense	1	1		
Mycobacterium scrofulaceum	1	1		
Mycobacterium obuense	1			1
Mycobacterium xenopi	1	1		
Total Mycobacteria	**414**	334	77	3

[1] Some patients have isolates in more than one source

Table 20. Mycobacteria Antimicrobial Susceptibility Testing

1. ***Mycobacterium tuberculosis:***
   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*, *M. fortuitum group*** and ***M. mucogenicum*):**
   Performed on one isolate per patient, testing performed inhouse. Additional agents on request.

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

4. **Other Nontuberculous Mycobacteria (NTM):**
   M. kansasii – Performed on one isolate per patient, at reference lab. Other NTM by physician request.

Table 21. California Mycobacterium tuberculosis % Resistant, 2011- 2017*

Antimicrobial Agent	2011	2012	2013	2014	2015	2016	2017
Isoniazid	10.9%	10.0%	10.6%	9.8%	10.9%	10.9%	7.6% †
Rifampin	2.2%	0.9%	1.8%	1.3%	1.4%	1.8%	0.4% †
Ethambutol	1.6%	0.9%	1.1%	0.8%	0.7%	ND	ND
Pyrazinamide	7.0%	6.7%	6.7%	5.5%	5.1%	5.4%	4.5% †
Multi-drug Resistant Tuberculosis rates[1]	2.0%	0.8%	1.6%	1.1%	1.3%	1.8%	1.8%
MTB Case rates per 100,000 population	6.2%	5.7%	5.6%	5.5%	5.5%	5.2%	5.2%
Number of Cases	2321	2186	2163	2130	2131	2059	2057

* Based on California Department of Public Health Annual report "*Report on Tuberculosis in California*"

† Non MDR cases

[1] MDR = Resistant to Isoniazid and Rifampin

[2] ND = No Available Data

Table 22. Rapid Grower - Mycobacteria %Susceptible, 2012 - 2018

Organism	No. Isolates	Amikacin	Cefoxitin	Ciprofloxacin	Clarithromycin	Doxyclycline	Imipenem	Trimethoprim-sulfamethoxazole	Tobramycin
Mycobacterium abscessus complex [1, 4]	75	95	19	R[2]	50	R	32	R	–[3]
Mycobacterium fortuitum	74	100	14	100	5	38	97	97	–
Mycobacterium chelonae	91	88	1	11	97	13	31	6	96
Mycobacterium mucogenicum	120	100	100	98	100	87	100	100	–

[1] *M. abscessus* complex is differentiated into 3 subspecies: *M. abscessus* subsp. a*bscessus, M. abscessus* subsp. *massiliense* and *M. abscessus* subsp. *bolletii.*

[2] R = Intristic resistance.

[3] – = Not routinely tested and/or not applicable.

Table 23. Anaerobic bacteria, %Susceptible [1]

***Bacteroides* spp. and *Parabacteroides* 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
Breakpoints %S		≤8/4		≤16/4		≤16		≤4		≤4		≤4		≤2		≤2		≤8
Bacteroides fragilis	129	84	1030	96	830	100	133	82	189	97	1505	93	1013	26	256	61	1140	100
Bacteroides thetaiotaomicron	76	82	252	87	258	13	–	–	70	100	328	99	328	28	70	54	322	100
Bacteroides ovatus	30	80	206	94	177	20	19[2]	84[2]	49	100	236	95	207	46	59	41	236	100
Bacteroides vulgatus	20[2]	45[2]	168	92	153	73	–	–	35	97	171	96	171	53	29[2]	31[2]	186	100
Bacteroides uniformis	19[2]	84[2]	78	96	72	85	–	–	19[2]	100[2]	93	100	87	45	25[2]	48[2]	89	100
Parabacteroides distasonis	27[2]	59[2]	92	95	82	29	–	–	26[2]	100[2]	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
Breakpoints %S		≤8/4		≤32/4		≤4		≤4		≤0.5		≤2		≤2		≤8
Prevotella species	29[2]	97[2]	63	100	29	100	92	98	63	100	29[2]	69[2]	92	66	92	99
Fusobacterium species	20[2]	100[2]	55	96	75	95	20[2]	100[2]	–	–	75	77	75	68	75	95
Anaerobic gram-positive cocci [3]	–	–	1853	99	134	99	1647	100	1647	100	1826	97	300	72	1692	100
Cutibacterium (Propionibacterium) acnes	–	–	18[2]	100[2]	17[2]	94[2]	–	–	–	–	17[2]	53[2]	114	95	18[2]	0[2]
Clostridium perfringens	15[2]	100[2]	410	100	23[2]	100[2]	417	100	402	90	425	83	23[2]	83[2]	425	100
Clostridioides (Clostridium) difficile	76	99	542	93	480	69	609	99	533	6	1013	32	480	74	1343	100
Other *Clostridium* species	–	–	439	94	71	99	390	100	390	69	461	67	71	62	461	100

[1] Adapted from CLSI M100S 29th ed.
[2] Calculated from fewer than the CLSI document M39 recommendation of 30 isolates.
[3] Anaerobic gram-positive cocci include *Peptococcus, Peptostreptococcus, Finegoldia, Peptoniphilus, and Anaerococcus* species.
[4] – Not routinely tested and/or not applicable.
[5] *Clostridoides (Clostridium) difficile* isolates are from an intestinal source; these results do not imply efficacy for intraluminal infections. Vancomycin minimum inhibitory concentrations for isolates were <4 µg/mL.

Table 24. Antimicrobials (IV,PO) Formulary Status and Cost Reference

Drug	Usual Dose	Usual Interval	($)*Per Day
Penicillins			
Ampicillin	1 gm	q6h	25.55
Ampicillin	2 gm	q6h	29.60
Ampicillin-sulbactam	3 gm	q6h	77.85
Oxacillin(24-hr infusion)	12 gm	q24h	63.75
Penicillin G (24-hr infusion)	24 million units	q24h	42.95
Piperacillin-tazobactam (Extended 4-hr infusion)	3.375 gm	q8h	29.55
Amoxicillin (PO)	500 mg	q8h	0.25
Amoxicillin-clavulanic acid (PO)	500 mg	q8h	1.05
Amoxicillin-clavulanic acid (PO)	875 mg	q12h	0.60
Dicloxacillin (PO)	500 mg	q6h	2.80
Cephalosporins			
Cefazolin	1 gm	q8h	9.05
Cefepime[1,2]	1 gm	q8h	24.05
Cefepime[1,2]	2 gm	q8h	37.00
Cefoxitin[1,3]	1 gm	q6h	37.30
Ceftriaxone	1 gm	q24h	8.05
Ceftriaxone	2 gm	q24h	15.35
Cephalexin (PO)	500 mg	q6h	0.85
Cefpodoxime (PO-UTI)	100 mg	q12h	8.45
Cefpodoxime (PO)	200 mg	q12h	8.25
Carbapenems/monobactam			
Aztreonam[1,4]	2 gm	q8h	197.90
Ertapenem[1,5]	1 gm	q24h	82.05
Meropenem[1,6]	1 gm	q8h	44.15
Aminoglycosides			
Amikacin[1,7]	1000 mg (15 mg/kg/dose)	q24h	14.00
Gentamicin	500 mg (7 mg/kg/dose)	q24h	15.20
Tobramycin[1,8]	500 mg (7 mg/kg/dose)	q24h	11.15

Table 24. Antimicrobials (IV,PO) Formulary Status and Cost Reference (cont.)

	Usual Dose	Usual Interval	($)*Per Day
Others			
Azithromycin	500 mg	q24h	7.50
Ciprofloxacin	400 mg	q12h	5.35
Clindamycin	600 mg	q8h	21.40
Colistimethate[1,9]	150 mg (CBA)**	q12h	60.85
Daptomycin[1,10]	500 mg	q24h	131.95
Doxycycline	100 mg	q12h	43.60
Levofloxacin[1,11]	750 mg	q24h	1.95
Linezolid[1,12]	600 mg	q12h	52.05
Metronidazole	500 mg	q8h	3.00
Rifampin[1,13]	600 mg	q24h	72.15
Tigecycline[1,9]	50 mg	q12h	153.45
TMP/SMX***	320 mg TMP	q12h	38.45
Vancomycin	1 gm	q12h	14.75
Azithromycin (PO)	500 mg	q24h	1.35
Ciprofloxacin (PO)	500 mg	q12h	0.25
Clarithromycin (PO)	500 mg	q12h	7.50
Doxycycline (PO)	100 mg	q12h	2.20
Levofloxacin (PO)[1,12]	750 mg	q24h	0.35
Linezolid (PO)[1,13]	600 mg	q12h	10.65
Metronidazole (PO)	500 mg	q8h	0.90
Nitrofurantoin (PO) (macrocrystal formulation)	100 mg	q6h	7.30
Rifampin (PO)	600 mg	q24h	1.40
TMP/SMX (PO)	160 mg/800 mg	q12h	0.30
Vancomycin (PO-cap)	125 mg	q6h	9.30
Vancomycin (PO-susp)	125 mg	q6h	5.55

Table 24. Antimicrobials (IV,PO) Formulary Status and Cost Reference (cont.)

Drug	Usual Dose	Usual Interval	($)*Per Day
Antifungal Agents			
Amphotericin B	50 mg	q24h	36.35
Amphotericin B Liposomal (AmBisome)[1,10]	350 mg	q24h	529.60
Caspofungin[1,10]	50 mg	q24h	57.10
Fluconazole	400 mg	q24h	3.75
Isavuconazonium[1,9]	372 mg	q24h	291.00
Posaconazole[1,5,13,14]	300 mg	q24h	486.05
Voriconazole[1,15]	300 mg	q12h	137.00
Fluconazole (PO)	400 mg	q24h	3.20
Isavuconazonium (PO)[1,9]	372 mg	q24h	167.90
Posaconazole (PO-susp)[1,5,14]	200 mg	TID	151.10
Posaconazole (PO-DR)[1,5,14]	300 mg	q24h	177.65
Voriconazole (PO)[1,15]	200 mg	q12h	39.95

* 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

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

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

3 Restricted: surgical prophylaxis; refer to Pre-incisional Antimicrobial Recommendations.

4 Restricted: aerobic gram-negative infections in beta-lactam allergic patients.

5 For Pediatric patients: restricted to use by Pediatric Infectious Diseases Service approval.

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

7 Restricted: organisms with suspected/documented resistance to gentamicin and tobramycin.

8 Restricted: infections caused by organisms with suspected/documented resistance to gentamicin.

9 Restricted: requires formal consultation by an Infectious Diseases physician

10 Restricted to use by Adult or Pediatric Infectious Diseases Service approval.

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

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

13 Injection: For use in patients unable to tolerate the oral formulations.

14 For prophylaxis of invasive *Aspergillus* and *Candida* infections in severely immunocompromised patients

15 Restricted: treatment of suspected/documented 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 25. Indications for Performing Routine Antimicrobial Susceptibility Tests – Aerobic Bacteria

Susceptibility tests will be performed as follows:

1. Blood—all isolates except*:

Aerococcus spp.[1]
Bacillus spp.[1]
Corynebacterium spp. [1]
Coagulase-negative *Staphylococcus* [1, 2]
Cutibacterium (Propionibacterium) acnes[1]
Micrococcus spp.[1]
Viridans group *Streptococcus*[1]

2. Urine

>10^5 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
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] (≤ 3 mo. only)
Shigella spp.
Yersinia spp.
Vibrio spp.

* Neonates, susceptibilities performed on all isolates
[1] Susceptibilities performed if isolated from multiple cultures
[2] Susceptibilities performed on all isolates of *S. lugdunensis*
[3] Susceptibilities performed on all isolates of *S. typhi* and *S. paratyphi*

Table 25. (cont.) Indications for Performing Routine Antimicrobial Susceptibility Tests – Aerobic Bacteria

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:

- **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 26. Antimicrobial Agents Routinely Reported – Aerobic Bacteria

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)[1, 4]
***E. coli, Klebsiella* spp., *P. mirabilis* – Excludes urine isolates**		
ceftriaxone[5]	Resistant to ceftriaxone	ertapenem (>18 y.o), imipenem & meropenem (≤18 y.o)
ciprofloxacin (>11 y.o.)	Resistant to ertapenem (>18 y.o)	imipenem, meropenem
gentamicin	Resistant to gentamicin	amikacin, tobramycin
piperacillin-tazobactam[5]	Resistant to piperacillin-tazobactam	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
trimethoprim-sulfamethoxazole		
	Resistant to meropenem or imipenem	ceftazidime-avibactam & colistin
***E. coli, Klebsiella* spp., *P. mirabilis* – Urine isolates**		
ampicillin		
oral cephalosporins[3]		
ceftriaxone[5]	Resistant to ceftriaxone	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
	Resistant to ertapenem (>18 y.o.)	imipenem, meropenem
ciprofloxacin(>11 y.o.)		
gentamicin	Resistant to gentamicin	amikacin
nitrofurantoin		
piperacillin-tazobactam[5]	Resistant to piperacillin-tazobactam	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
trimethoprim-sulfamethoxazole		
	Resistant to meropenem or imipenem	ceftazidime-avibactam & colistin
SPICE organisms[2] – Excludes urine isolates		
cefepime[5]	Resistant to cefepime	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
ciprofloxacin (>11 y.o.)	Resistant to ertapenem (>18 y.o.)	imipenem, meropenem
gentamicin	Resistant to gentamicin	amikacin, tobramycin
piperacillin-tazobactam[5]	Resistant to piperacillin-tazobactam	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
trimethoprim-sulfamethoxazole		
	Resistant to meropenem or imipenem	ceftazidime-avibactam & colistin
SPICE organisms[2] – Urine isolates		
ampicillin		
cefepime[5]	Resistant to cefepime	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
ciprofloxacin (>11 y.o.)		
	Resistant to ertapenem (>18 y.o.)	imipenem, meropenem
gentamicin	Resistant to gentamicin	amikacin
nitrofurantoin		
piperacillin-tazobactam[5]	Resistant to piperacillin-tazobactam	ertapenem (>18 y.o.), imipenem & meropenem (≤18 y.o)
trimethoprim-sulfamethoxazole		
	Resistant to meropenem or imipenem	ceftazidime-avibactam & colistin

[1] The following antimcrobial agents are reported on carbapenem reistant gram-negative rods (resistant to meropenem and/or imipenem): Fosfomycin, Minocycline, Moxifloxacin, Colistin, Tigecycline, Ceftazidime-avibactam and Ceftolozane-tazobactam.

[2] *Enterobacteriaceae* other than *E. coli, Klebsiella* spp., *P. mirabilis*, *Salmonella* spp., *Shigella* spp.

[3] Cefazolin results should only be used to predict potential effectiveness of oral cephalosporins for uncomplicated UTIs.

[4] Colistin is not reported on *Serratia marcesens, Proteius spp., Providencia spp. and Morganella morganii* because these organisms are intermediate/resistant to colistin.

[5] If result is intermediate (I) or resistant (R): ertapenem, imipenem (≤ 18 y.o.) and meropenem (≤ 18 y.o.) are reported.

Table 26. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)[1]
***Salmonella* spp.[1], *Shigella* spp.[2]**		
ciprofloxacin (>11 y.o) trimethoprim-sulfamethoxazole	 Non-fecal sources/resistant to all primary antimicrobials	 azithromycin (*S. flexneri* and *S. sonnei*) ceftriaxone
Pseudomonas aeruginosa		
cefepime ciprofloxacin (>11 y.o.) gentamicin piperacillin-tazobactam ceftazidime	Resistant to cefepime Resistant to imipenem or meropenem If gentamicin > 1 ug/ml Resistant to piperacillin-tazobactam	imipenem, meropenem, ceftolozane - tazobactam colistin, ceftolozane - tazobactam amikacin, tobramycin imipenem, meropenem
***Acinetobacter* spp.**		
cefepime ceftazidime ciprofloxacin (>11 y.o.) gentamicin piperacillin-tazobactam trimethoprim-sulfamethoxazole	 Resistant to ceftazidime Resistant to meropenem or imipenem Resistant to gentamicin	 imipenem, meropenem minocycline, colistin amikacin, tobramycin
Stenotrophomonas maltophilia*- Sterile body site isolates** ***Burkholderia cepacia		
ceftazidime levofloxacin (>11 y.o.) meropenem (*B. cepacia* only) minocycline trimethoprim-sulfamethoxazole		

[1] If stool isolates, perform on patients ≤3 mo., or if isolate is *Salmonella typhi* or S*almonella paratyphi A*.

[2] Susceptibility performed on stool isolates.

Table 26. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)

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

Table 26. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)
***Staphylococcus* spp.**		
clindamycin[3]		
oxacillin	Resistant to oxacillin (MRSA)	doxycycline, trimethoprim-sulfamethoxazole; all beta-lactams considered resistant except ceftaroline
penicillin		
vancomycin	*S. aureus* on blood (vancomycin ≥ 2µg/ml)	daptomycin, linezolid
	Urine isolates	ciprofloxacin[4], nitrofurantoin, trimethoprim-sulfamethoxazole
***Enterococcus* spp.**		
ampicillin		
vancomycin	Resistant to vancomycin (VRE) from sterile body sites	daptomycin, doxycycline, linezolid, quinupristin-dalfopristin (excluding *E. faecalis*), rifampin
	Sterile body site isolates	gentamicin (high level)
	Urine isolates	ciprofloxacin[4], doxycycline, nitrofurantoin
Streptococcus pneumoniae		
amoxicillin, cefotaxime, ceftriaxone, erythromycin[3], levofloxacin[4], penicillin, tetracycline[5], trimethoprim-sulfamethoxazole[5], vancomycin		
Viridans group *Streptococcus*		
cefotaxime, ceftriaxone, penicillin, vancomycin		
Beta-hemolytic *Streptococcus*		
clindamycin[3], penicillin, vancomycin		
Listeria monocytogenes		
penicillin, trimethoprim-sulfamethoxazole (penicillin results predicts ampicillin results)		

[3] excluding urine and sterile body site isolates
[4] patients >11 y.o.
[5] excluding CSF isolates

Table 27: Expected Antimicrobial Susceptibility Patterns of the Most Commonly Isolated Nocardia*

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

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*

S = Susceptible

R = Resistant

V = Variable

Table 28. Susceptible MIC (µg/mL) Breakpoints for Aerobic Gram-negative Bacilli

Organism	Penicillins			Cephalosporins					Carbapenems			Aminoglycosides			Fluoroquinolones		Other						
	Ampicillin	Ampicillin-sulbactam	Piperacillin-tazobactam	Cefazolin	Cefepime	Cefotaxime	Ceftazidime	Ceftriaxone	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin[1]	Levofloxacin[2]	Colistin	Trimethoprim – sulfamethoxazole	Nitrofurantoin	Minocycline	Tigecycline	Ceftolozane-tazobactam	Ceftazidime-avibactam
ENTEROBACTERIACEAE[3]	≤8	≤8	≤16	≤2	≤2	≤1	≤4	≤1	≤.5	≤1	≤1	≤16	≤4	≤4	≤1	≤2	≤2[6]	≤2/38	≤32	≤4	≤2	≤2/4	≤8/4
NONFERMENTERS																							
Acinetobacter baumannii	R[4]	≤8	≤16	R	≤8	≤8	≤8	≤8	R	≤2	≤2	≤16	≤4	≤4	≤1	≤2	≤2	≤2/38	–[5]	≤4	–	–	–
Burkholderia cepacia	R	R	R	R	R	–	≤8	R	R	R	≤4	R	R	R	–	≤2	R	≤2/38	–	≤4	–	–	–
Pseudomonas aeruginosa	R	R	≤16	R	≤8	R	≤8	R	R	≤2	≤2	≤16	≤4	≤4	≤1	≤2	≤2	R	–	–	R	≤4/4	≤8/4
Stenotrophomonas maltophilia	R	R	R	R	–	R	≤8	R	R	R	R	R	R	R	–	≤2	–	≤2/38	–	≤4	–	–	–
Other nonfermenters	–	–	≤16	–	≤8	≤8	≤8	≤8	–	≤4	≤4	≤16	≤4	≤4	≤1	≤2	–	≤2/38	–	≤4	–	–	–

[1] *Salmonella* spp. breakpoint for ciprofloxacin ≤ 0.06 µg/ml

[2] *Salmonella* spp. breakpoint for levofloxacin ≤ 0.12 µg/ml

[3] *Enterobacteriaceae*: *Citrobacter, Enterobacter* spp., *Escherichia coli, Klebsiella* spp., *Morganella, Proteus spp., Providencia spp., Salmonella* spp., S*erratia* spp., *Shigella* spp.

[4] R Intrinsic resistance

[5] – Not routinely tested and/or not applicable.

[6] There are currently no interpretive criteria (breakpoints) for colistin and these organisms. The MIC is based on Epidemiological Cutoff Value (ECV); isolate whose MIC is below the wild type MIC, which suggests this isolate does not have any acquired or mutational mechanisms of resistance to colistin. The clinical implication of this finding is currently unknown. Infectious diseases consultation strongly recommended.

Table 29. Susceptible MIC (µg/mL) Breakpoints for Aerobic Gram-positive Cocci

Organism	Penicillins			Cephalosporin	Aminoglycosides		Fluoroquinolone	Other									
	Ampicillin	Oxacillin	Penicillin	Ceftaroline[1]	Gentamicin	Gentamicin synergy	Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Nitrofurantoin	Quinupristin-dalfopristin	Rifampin	Trimethoprim – sulfamethoxazole	Vancomycin
Staphylococcus aureus *Staphylocccus lugdunensis*	—[1,4]	≤2	≤.12[2]	≤1	≤4	—	≤1	≤.5	≤1	≤4	≤.5	≤4	≤32	≤1	≤1	≤2/38	≤2
Coagulase-negative *Staphylococcus*	—	≤.25	≤.12[2]	—	≤4	—	≤1	≤.5	≤1	≤4	≤.5	≤4	≤32	≤1	≤1	≤2/38	≤4
Enterococcus spp.	≤8	—	≤8	R[3]	R	≤500	≤1	R[2]	≤4	≤4	R	≤2	≤32	≤1	≤1	R	≤4

[1] *S. aureus* only, including MRSA
[2] beta-lactamase
[3] R - Inrinstic resistance
[4] — = Not routinely tested and/or not applicable.

Organism	Penicillins		Cephalosporins		Tetracyclines		Other		
	Amoxicillin	Penicillin	Cefotaxime	Ceftriaxone	Doxycycline	Tetracycline	Erythromycin	Levofloxacin	Vancomycin
Streptococcus pneumoniae	—	—	—	—	≤.25	≤1	—	≤2	≤1
Meningitis	—	≤.06	≤.5	≤.5	—	—	—	—	—
Non-meningitis	≤2	≤2	≤1	≤1	—	—	≤.25	—	—
Viridans group *Streptococcus*	—	≤.12	≤1	≤1	—	—	—	—	≤1

[1] — = Not routinely tested and/or not applicable.

Table 30. Antimicrobial Stewardship

1) Treatment of asymptomatic bacteriuria
    a. A urine culture must ALWAYS be interpreted in the context of the urinalysis and patient symptoms, consider adding UA with reflex to culture (LAB)
    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**.
    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:
        1) addition of metronidazole to another agent with anaerobic activity to treat *Clostridium difficile* infection
        2) 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/

Tables 1-4
Adults

Tables 5-8
Adults/Peds

Tables 9-11
Peds

Tables 12
Yeasts

Tables 13-16
Emerging Restist. Concerns

Tables 17-23
Misc

Tables 24-29
Lab Info

Table 30
Antimicrobial Stewardship Program

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: (310) 267-7567
Email: asp@ucla.edu
Website: http://www.asp.mednet.ucla.edu Note that the website has a **guidebook**, with detailed information about specific clinical syndromes, interpretation of microbiology reports, and guidelines for treatment.
eConsult: http://www.asp.mednet.ucla.edu/pages/econsult

We encourage you to reach out to the program with questions. The program is staffed by Dr. Daniel Uslan (ID), Dr. Elise Martin (ID), Dr. Christine Pham (Pharm – SM), Dr. Jennifer Curello (Pharm – RR), and Dr. Meganne Kanatani (Pharm – RR).