



Stanford
HEALTH CARE

CLINICAL MICROBIOLOGY LABORATORY

SHC ANTIBIOGRAM DATA FOR BACTERIAL AND YEAST ISOLATES

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SITUATIONS FOR WHICH THE USE OF VANCOMYCIN IS APPROPRIATE AND ACCEPTABLE:

- For treatment of serious infections due to β -lactam-resistant gram-positive bacteria. Clinicians should be aware that vancomycin is usually less active and less rapidly bactericidal than β -lactam agents for organisms that are susceptible to the β -lactams. Clinicians should also be aware that vancomycin sensitive MIC 2mcg/ml is associated with increased treatment failures.
- For treatment of infections due to gram-positive organisms in patients with serious allergy to β -lactam-antibiotics.
- Prophylaxis, (infused 60-120 min before the first incision), in penicillin-allergic patients, as recommended by the Amer. Heart Assoc., for endocarditis following certain procedures in patients at high risk for endocarditis. Cephalosporins are still recommended for non-allergic patients.
- Prophylaxis for major surgical procedures involving implantation of prosthetic materials or devices, e.g., cardiac and vascular procedures and total hip replacements, at institutions with a high rate of infections due to MRSA or MRCoNS. Currently MRSA and MRCoNS rates are 24% and 58% at SHC, respectively. A single dose administered 60-120 min before surgery is sufficient unless the procedure lasts more than 6 hours, in which case the dose should be repeated. Prophylaxis should be dc'd after 2 doses maximum.

Streptococci and Enterococci																			
Percent Susceptible	No. Tested (a)	Penicillin or Ampicillin			Cefuroxime	Ceftriaxone	Vancomycin	Erythromycin	Clindamycin (b)	Meropenem	Trimethoprim/sulfa	Tetracycline (Doxycycline)	Gentamicin Synergy with Pen/Amp	Streptomycin Synergy with Pen/Amp	Moxifloxacin	Nitrofurantoin (UTI only)	Levofloxacin (UTI only)	Ciprofloxacin (UTI only)	Linezolid
		%S	%I	%R															
Streptococci																			
Grp. B (Strep. agalactiae)	210	100	0	0	-	-	-	48	54	-	-	-	-	-	-	-	-	96	-
Viridans (various species)	149	74	26	0	-	100	100	64	84	-	-	-	-	-	-	-	-	-	-
Strep. pneumoniae (c)	22	82d	-	18	90	100d	100	77	94	91	86	Doxy	75	-	100	-	-	-	-
Enterococcus (no species I.D.) (e)																			
Enterococcus faecalis (e)	134	100	0	0	-	-	100	-	-	-	-	-	81	84	-	-	-	-	99
Enterococcus faecium (e)	100	20	0	80	-	-	52	-	-	-	-	-	91	14	-	-	-	-	97
Cost (\$)		\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$

- (a) First isolate from each patient was included.
 (b) Penicillin is the drug of choice for all beta hemolytic streptococci; penicillin resistance has not been documented. Clindamycin induction test performed on all beta hemolytic streptococci and S. pneumoniae.
 (c) Penicillin-susceptible isolates are also susceptible to all other β -lactam agents. β -lactamase inhibitor combination drugs do not add additional efficacy to penicillin alone. Data from <30 isolates may be statistically unreliable.
 (d) Based on meningitis interpretive criteria (more conservative). Nonmeningitis interpretation is 100% for penicillin. Infectious diseases consultation is recommended for meningitis in penicillin-allergic patients or those with resistant ceftriaxone or cefotaxime results.
 (e) If susceptible, ampicillin is the drug of choice when enterococci must be treated. Nitrofurantoin or ampicillin is recommended for uncomplicated UTI. Serious infections (septicemia, endocarditis) require both a β -lactam agent and an aminoglycoside. Use vancomycin+aminoglycoside only if strain is ampicillin-resistant or patient is penicillin allergic. High level resistance to gentamicin also indicates lack of synergy for tobramycin, amikacin and kanamycin.

Candida					
Percent Susceptible or Susceptible-Dose Dependent by Broth Microdilution Method	No. Tested	Amphotericin B (a)	Caspofungin	Fluconazole (b)	Voriconazole
Candida albicans	65	100	100	97	93
Candida glabrata	36	100	92	83	-
Candida parapsilosis	27(c)	100	100	96	96
C. tropicalis	15(c,d)	100	100	87	40
Other Candida spp.	9(c,d)	100	67	(e)	57
Costs (\$)		\$\$\$\$	\$\$\$\$	\$	\$\$\$\$

- (a) Based on suggested resistant breakpoint MIC ≥ 2 μ g/ml.
 (b) Susceptible dose-dependent breakpoint MIC was used.
 (c) Data from <30 isolates may be statistically unreliable.
 (d) Includes isolates form 2019.
 (e) C. krusei is intrinsically resistant to fluconazole.

Gram negative rods

Percent Susceptible	PENICILLINS				CEPHEMS			LACTAMS			AMINOGLYC's			OTHERS			Urine	
	No. Tested (a)	Ampicillin	Amp/Subactam	Pip/Tazobactam	Cefazolin [Urine Only]	Ceftriaxone	Cefepime	Aztreonam (b)	Imipenem	Meropenem	Ertapenem	Gentamicin	Tobramycin	Amikacin	Ciprofloxacin	Levofloxacin	Trimeth/Sulfamethox	Nitrofurantoin
Achromobacter xylosoxidans	18(c)	-	-	94	-	-	6	0	-	78	-	6	6	0	6	67	94	-
Acinetobacter baumannii	25(c)	-	72	-	-	64	-	-	84	-	80	96	96	72	80	72	-	-
Burkholderia cepacia complex (d)	15(c,e)	Ceftazidime 80%				Minocycline 87%			-	71	-	-	-	-	-	-	80	-
Citrobacter freundii complex	109	0	0	86	0	80	96	71	100	100	100	93	96	100	94	88	85	95
Citrobacter koseri	80	0	92	99	96	98	100	96	100	100	100	98	100	100	96	96	99	82
Enterobacter cloacae complex	183	0	0	73	0	69	94	66	93	99	87	97	96	100	94	95	89	54
Escherichia coli	2737	51	45	95	83	86	76	76	100	100	100	89	88	100	73	69	71	96
Klebsiella aerogenes (f)	106	0	0	79	0	76	96	84	81	98	95	98	98	100	95	92	98	11
Klebsiella oxytoca	122	0	60	92	60	90	93	86	100	100	99	92	91	100	93	93	86	87
Klebsiella pneumoniae	651	0	72	94	86	90	81	84	98	99	98	94	93	100	89	88	88	16
Morganella morganii	60	0	0	100	0	95	100	100	-	100	100	88	97	100	83	82	78	0
Proteus mirabilis	296	80	94	100	90	95	98	100	-	100	100	91	91	100	86	87	79	0
Proteus vulgaris group	16(c)	0	83	100	0	69	-	-	-	100	100	100	100	100	100	100	88	0
Pseudomonas aeruginosa	533	-	-	95	C/T 99%	95	84	91	95	-	92	99	97	89	81	-	-	-
Ps. aeruginosa CF mucoid (d)	98	-	-	87	C/T 94%	78	77	78	82	-	-	94	71	54	42	-	-	-
Ps. aeruginosa CF non-mucoid (d)	54	-	-	82	C/T 91%	72	76	57	69	-	-	63	43	59	48	-	-	-
Salmonella enterica	15(c)	93	-	-	93	-	-	-	-	-	-	-	-	79	-	93	-	-
Serratia marcescens	98	0	0	93	0	90	100	96	-	99	97	100	94	99	83	91	98	0
Stenotrophomonas maltophilia	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	100	-
Cost		\$\$	\$	\$\$	\$	\$	\$\$\$	\$\$\$	\$\$	\$\$	\$	\$	\$	\$	\$	\$	\$	\$

C/T= Cefzolozane/Tazobactam

- (a) First isolate from each patient was included.
- (b) Unlike aztreonam, aminoglycosides have synergistic activity with β-lactams (ex: piperacillin, ampicillin) against aerobic gram negative rods and enterococci. Aztreonam should only be used for treating documented infections due to susceptible organisms in patients with anaphylactic reactions to β-lactams. In patients with renal insufficiency, aminoglycosides can be administered safely when doses are adjusted for patient's renal function. For information on dosing, including single daily dosing, please contact a Clinical Pharmacist (beeper # available from unit secretary).
- (c) Data from isolate totals <30 may be statistically unreliable.
- (d) Cystic fibrosis patient isolates tested by disk diffusion.
- (e) Includes isolates from 2019.
- (f) Formerly known as Enterobacter aerogenes.

Interpretation of susceptibility results

Results are reported as minimum inhibitory concentrations (MICs), the minimum amount of drug needed to inhibit growth *in vitro*. Interpretive criteria are based on achievable serum levels. For certain antibiotics, the amount excreted into the urine via the kidneys is above the MIC, and the agent is effective clinically in this site even though reported as "resistant". Intermediate results (I), especially for beta-lactam agents, indicate that doses higher than standard recommendations may be effective. In other cases, "I" results indicate that the organism may be susceptible or resistant but the *in vitro* tests are not sensitive enough to determine specifically. For this antibiogram, Intermediate results are NOT included within the "%S" category.

Staphylococci

Percent Susceptible	No. Tested	Penicillin	Nafcillin, Oxacillin (b,c)	1st Generation Cepheims (c)	Vancomycin	Erythromycin	Clindamycin (d)	Gentamicin	Trimeth/Sulfa	Moxifloxacin	Tetracycline (oxy)	Linezolid	Haemophilus influenzae
													For infections with β-lactamase-producing H. influenzae: cefuroxime, cefotaxime, trimethoprim/sulfamethoxazole, amoxicillin/clavulanate or azithromycin is recommended. Cefotaxime or ceftriaxone is drug of choice for CNS infections. At Stanford, 76% of H. influenzae (n=55) are ampicillin susceptible.
Staphylococcus aureus, ALL(b)	1251	(a)	76	76	100	57	72	96	99	74	93	100	
MRSA (ONLY) (c)	290	0	0	0	100	17	56	93	96	29	87	100	
MSSA (ONLY)	961	(a)	100	100	100	69	76	97	99	87	95	100	
Staph. lugdunensis	49	(a)	92	92	100	80	78	96	100	100	96	100	
Staph. coagulase negative (other)	208	(a)	42	42	100	32	58	79	62	60	79	100	
Cost (\$)		\$	\$\$	\$	\$	\$	\$	\$	\$	\$	\$	\$\$\$	

- (a) Penicillin sensitivity confirmed per request. Penicillin-resistant staphylococci should be considered resistant to all penicillinase-labile penicillins, including ampicillin, amoxicillin, piperacillin and ticarcillin.
- (b) For empiric therapy where S. aureus is a potential pathogen, nafcillin and first generation cephalosporins are recommended drugs of choice for infections other than serious or systemic, for which vancomycin should be used until the susceptibility results are available. Vancomycin MIC 2 mg/ml, currently interpreted sensitive, is associated with increased treatment failure.
- (c) Oxacillin resistant staphylococci (MRSA & MRSE) should be considered resistant to all penicillins, cephalosporins (except ceftazolin), imipenem and beta-lactams including combinations with clavulanic acid, subactam and tazobactam. Oxacillin susceptibility predicts susceptibility to all other beta-lactams and cephalosporins.
- (d) Clindamycin induction test performed on all staphylococcal isolates.

Anaerobes (selected species)

Percent Susceptible by Etest	No. Tested (a,e)	Penicillin	Amp/subactam	Pip/tazobactam	Meropenem	Clindamycin	Metronidazole	(a) Not all isolates tested with every drug
								(b) Include Fusobacterium, Prevotella, Porphyromonas, & other.
Bacteroides fragilis	27	0	96	-	93	74	100	(c) Non-sporeforming rods include Actinomyces, Bifidobacterium, Lactobacillus, Cutibacterium, and others.
Bacteroides sp. NOT fragilis	31	0	65	-	94	29	100	(d) Notify Micro Lab to perform antibiotic susceptibility testing if clindamycin is being considered for a Peptostreptococcus.
Gram negative rods (other) (b)	37	46	100	-	100	43	100	(e) <30 isolates may be statistically unreliable
Clostridium perfringens	20	95	100	-	100	45	100	
Clostridium sp. NOT perfringens	26	91	100	-	96	75	100	
Gram positive rods (other) (c)	33	100	100	-	100	93	67	
Gram positive cocci	25	100	100	-	100	80(d)	84	
Cost (\$)		\$	\$	\$\$	\$\$	\$\$	\$	

Campylobacter sp. (n = 24)

Drug	%Susceptible
Ciprofloxacin	46
Doxycycline	50
Erythromycin	92

M. tuberculosis (n = 14)

Drug (mcg/mL)	%Susceptible
Isoniazid (0.1)	93
Rifampin (1)	100
Ethambutol (5)	100
Pyrazinamide (100)	92