



STANFORD HOSPITAL & CLINICS

Stanford University Medical Center

CLINICAL MICROBIOLOGY LABORATORY

SUH ANTIBIOGRAM DATA FOR BACTERIAL AND YEAST ISOLATES

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Antibiograms for ICUs can be found at <http://lane.stanford.edu/local/antibiogram/>

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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 MRSE. Currently MRSA and MRSE rates are 31% and 73% 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 by Broth Microdilution, Etest, or Disk Diffusion	No. Tested (a)	Penicillin or Ampicillin			Cefuroxime	Ceftriaxone	Vancomycin	Erythromycin	Clindamycin	Meropenem	Trimethoprim/sulfa	Tetracycline (Doxycycline)	Gentamicin Synergy with Pen/Amp	Streptomycin Synergy with Pen/Amp	Moxifloxacin	Nitrofurantoin (UTI only)	Quinopristin/dalfopristin	Ciprofloxacin	Linezolid
		%S	%I	%R															
Streptococci																			
Grp. B (Strep. agalactiae) (b)	294	100	0	0	-	100	-	59	61	-	-	-	-	-	-	-	-	-	-
Viridans (various species) (c)	147	84	15	1	-	95	100	63	80	-	-	-	-	-	-	-	-	-	-
Strep. pneumoniae (d)	62	81e	-	19	89	90	100	77	85	90	75	-	-	100	-	-	-	-	-
Enterococcus (no species I.D.) (f)																			
Enterococcus faecalis (f)	495	84	0	16	-	-	88	-	-	-	-	27	-	-	-	86	-	66	100
Enterococcus faecium (f)	106	100	0	0	-	-	100	-	-	-	-	62	60	-	100	-	75	100	100
Enterococcus faecium (f)	114	12	0	88	-	-	32	-	-	-	-	50	94	50	-	40	88	20	98
Cost (\$)		\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$

- (a) Not all isolates tested against every antibiotic listed.
 (b) Penicillin is the drug of choice for all beta hemolytic streptococci; penicillin resistance has not been documented.
 (c) Clinically important species tested; MICs for penicillin and ceftriaxone performed on 146 strains.
 (d) 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.
 (e) Based on meningitis interpretive criteria (more conservative). Nonmeningitis interpretation is 100%. Infectious diseases consultation is recommended for meningitis in penicillin-allergic patients or those with resistant ceftriaxone or cefotaxime results.

(f) If susceptible, ampicillin is the drug of choice when enterococci must be treated. Ampicillin susceptibility predicts piperacillin susceptibility. 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.

- (a) Suggested Ampho Resistant breakpoint MIC > or = 2 mcg/ml
 (b) Data from <10 isolates may be statistically unreliable
 (c) Includes C. tropicalis, lusitanae, and others

Candida	Percent Susceptible By Broth Microdilution (YeastOne, Trek Diagnostics)	No. Tested	Amphotericin B (a)	Caspofungin	Fluconazole	Itraconazole	Voriconazole
Candida glabrata	34	100	100	85	47	91	
Candida parapsilosis	18	100	100	94	100	100	
C. krusei (b)	8	100	100	0	88	100	
Other Candida spp. (c)	23	100	100	83	87	87	
Costs (\$)		\$	\$\$\$\$	\$\$\$\$	\$\$\$\$	\$\$\$\$	

Gram negative rods (a)

Percent Susceptible by Broth Microdilution	No. Tested (b)	PENICILLINS				CEPHEMS			LACTAMS			AMINOGLYC's			OTHERS			Urine Only	
		Ampicillin	Piperacillin	Amp/Sulbactam	Pip/Tazobactam	Cefazolin	Cefotaxime	Cefepime	Aztreonam (c)	Imipenem	Meropenem	Gentamicin	Tobramycin	Amikacin	Ciprofloxacin	Levofloxacin	Trimeth/Sulfamethox	1ST GENERATION Cephs [oral]	Nitrofurantoin
Achromobacter xylosoxidans	21	-	-	-	80	-	-	0	0	95	85	0	0	0	45	85	-	-	
Acinetobacter baumannii	28	-	-	82	-	-	-	59	-	89	78	89	89	70	74	82	-	-	
Burkholderia cepacia (d,e)	7	Ceftazidime 83%				Minocycline 83			-	67	-	-	-	-	-	100	-	-	
Citrobacter freundii	41	37	-	74	74	5	82	100	85	100	95	93	100	90	93	81	-	96	
Citrobacter koseri	34	0	-	100	100	97	100	100	100	100	100	100	100	100	100	94	-	64	
Enterobacter aerogenes	60	3	-	49	90	20	86	98	90	100	100	100	100	100	100	98	-	13	
Enterobacter cloacae	96	7	-	20	90	1	79	95	84	100	100	96	99	100	94	96	88	27	
Escherichia coli	1300	52	-	61	98	87	91	95	94	100	100	88	88	100	77	77	71	96	
Klebsiella oxytoca	67	6	-	72	99	58	95	99	97	100	100	100	99	100	99	99	99	72	
Klebsiella pneumoniae	294	0	-	85	98	95	95	97	96	100	100	98	97	99	93	94	85	20	
Morganella morganii	32	0	-	9	94	0	100	100	97	-	-	84	91	100	84	-	74	0	
Proteus mirabilis	108	82	-	93	100	94	96	99	99	-	-	94	96	100	89	-	80	0	
Proteus vulgaris	10	0	-	100	100	0	-	100	100	100	100	100	100	100	100	80	-	0	
Pseudomonas aeruginosa	512(f)	-	-	-	94	-	-	82	71	87	88	81	89	94	71	68	-	-	
Ps. aeruginosa CF mucoid (e)	163(f)	-	79	Ticarcillin 73%			-	83	70	73	85	-	82	-	58	-	-	-	
Ps. aeruginosa CF non-mucoid (e)	91(f)	-	60	Ticarcillin 55%			-	52	48	57	63	-	50	-	33	-	-	-	
Salmonella spp. (g)	14	86	-	-	Ceftriaxone 100%	-	-	-	-	-	-	-	-	100	-	100	-	-	
Serratia marcescens	59	7	-	9	93	0	89	100	91	100	100	98	95	100	97	98	100	-	
Stenotrophomonas maltophilia	65	-	-	Ticarcillin/Clavulanate 46%	-	-	-	Levofloxacin 89%	-	-	-	-	-	-	-	98	-	-	
Cost		\$	\$\$\$	\$	\$\$\$	\$	\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$	\$	\$\$\$	\$\$\$	\$	\$	\$	

- (a) Until final identifications are available, reports describe gram negative rods as lactose-fermenters (LF; such as E.coli, Klebsiella, Enterobacter, Citrobacter); non-lactose fermenters (NLF, such as Proteus, Serratia, Salmonella, Shigella), or non-fermenters (NF, such as Pseudomonas, Acinetobacter, Stenotrophomonas, and others, most of which are intrinsically more resistant to many antibiotics).
- (b) Not all isolates tested against every antibiotic listed.
- (c) 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).
- (d) Data from isolate totals <10 may be statistically unreliable.
- (e) Cystic fibrosis patient isolates tested by disk diffusion.
- (f) Pseudomonas aeruginosa isolates not corrected for duplicates.
- (g) Infectious Diseases consultation strongly recommended for determining treatment of Salmonella sp. recovered from blood.

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 by Broth Microdilution	No. Tested	Penicillin (a)	Nafcillin, Oxacillin (b,c)	1st Generation Cepheims (c)	Vancomycin	Erythromycin	Clindamycin (d)	Gentamicin	Trimeth/Sulfa	Moxifloxacin	Tetracycline (body)	Linezolid
		Staphylococcus aureus, ALL(b)	959	17	69	69	100	54	82	98	99	55
MRSA (ONLY) (c)	295	0	0	0	100	6	52	98	98	10	92	100
Staph. epidermidis	57	4	27	27	98	37	60	77	63	-	-	-
Staph. lugdunensis	38	68	97	97	100	84	95	100	97	-	-	100
Staph. coagulase negative (other)	239	14	40	40	100	36	65	73	68	35	-	100
Cost (\$)		\$	\$	\$	\$	\$	\$\$	\$	\$	\$\$\$	\$	\$\$\$

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, 73% of H. influenzae are ampicillin susceptible.

- (a) Penicillin-resistant staphylococci should be considered resistant to all penicillinase-sensitive penicillins, including ampicillin, amoxicillin, mezlocillin, 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 2mcg/ml, currently interpreted sensitive, is associated with increased treatment failure.
- (c) Oxacillin resistant staphylococci (MRSA & MRSE) should be considered resistant to all penicillins, cephalosporins, imipenem and beta-lactams including combinations with clavulanic acid, sulbactam and tazobactam. Oxacillin susceptibility predicts susceptibility to all other beta-lactams.
- (d) Clindamycin induction test not performed on all staphylococcal isolates.

Anaerobes (selected species)

Percent Susceptible by Etest (a)	No. Tested	Amp/sulbactam	Penicillin	Pip/tazobactam	Meropenem	Clindamycin	Metronidazole
Bacteroides fragilis	30	97	0	93	97	77	97
Bacteroides NOT fragilis	25	92	0	80	92	24	91
Gram negative rods (other) (b)	31	100	100	100	100	83	100
ALL Gram positive rods	46	100	80	100	100	80	74 (c)
Clostridium perfringens only	10	-	100	-	-	70	100
Gram pos rods NOT perfringens	23	100	74	100	100	74	87
Peptostreptococci	20	-	100	-	-	85 (d)	95
Cost (\$)		\$\$	\$	\$\$\$	\$\$\$	\$\$	\$

- (a) Not all isolates tested with every drug
- (b) 13 Fusobacterium spp., 17 Prevotella spp., 1 Bacteroides spp.
- (c) Non-sporiforming anaerobic gram positive rods do not respond to metronidazole
- (d) Notify Micro Lab to perform antibiotic susceptibility testing if clindamycin is being considered for a Peptostreptococcus; minimum 48 H for results

Campylobacter sp. (n = 13)

Drug (mcg/mL)	% Resistant
Ciprofloxacin	54% R
Doxycycline	46% R
Erythromycin	8% R

M. tuberculosis (n = 31)

Drug (mcg/mL)	% Resistant
Isoniazid (0.1)	10% R
Rifampin	0% R
Ethambutol	0% R
Streptomycin (2)	10% R
Pyrazinamide	4% R