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)	413	100	0	0	–	–	–	54	61	–	–	–	–	–	–	–	96	–	–
Viridans (various species)	251	82	17	1	–	100	100	59	80	–	–	–	–	–	–	–	–	–	–
Strep. pneumoniae (c)	57	72d	–	28	94	96d	100	65	90	87	84	Doxy 56	–	–	100	–	–	–	–
Enterococcus (no species I.D.) (e)	943	91	0	9	–	–	92	–	–	–	–	25	–	–	–	96	82	72	100
Enterococcus faecalis (e)	146	100	0	0	–	–	99	–	–	–	–	–	84	81	–	–	–	–	99
Enterococcus faecium (e)	136	22	0	78	–	–	38	–	–	–	–	–	94	48	–	–	–	–	99
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.
(d) Based on meningitis interpretive criteria (more conservative). Nonmeningitis interpretation is 98% 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 (b)
Candida albicans	87	100	100	99	100
Candida glabrata	46	100	89	87	–
Candida parapsilosis	14(c)	100	93	93	100
C. tropicalis	14(c)	100	100	86	86
Other Candida spp.	18(c,d)	100	85	(e)	100
Costs ($)		$$$$	$$$$	$	$$$$

(a) Based on suggested resistant breakpoint MIC ≥2 μg/ml.
(b) Susceptible dose-dependent breakpoint MIC was used.
(c) Data from <30 isolates may be statistically unreliable.
(d) Includes isolates from 2017.
(e) C. krusei is intrinsically resistant to fluconazole.

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

1. 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.

2. For treatment of infections due to gram-positive organisms in patients with serious allergy to β-lactam-antibiotics.

3. 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.

4. 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 22% and 57% 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.

Stanford HEALTH CARE

CLINICAL MICROBIOLOGY LABORATORY

SHC ANTIBIOGRAM DATA FOR BACTERIAL AND YEAST ISOLATES

Jan 1, 2018 - Dec 31, 2018

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Gram negative rods

Percent Susceptible	PENICILLINS				CEPHEMS			LACTAMS				AMINOGLYC's			OTHERS			Urine
	No. Tested (a)	Ampicillin	Amp/Sulbactam	Pip/Tazobactam	Cefazolin [Urine Only]	Ceftriaxone	Cefepime	Aztreonam (b)	Imipenem	Meropenem	Ertapenem	Gentamicin	Tobramycin	Amikacin	Ciprofloxacin	Levofloxacin	Trimeth/Sulfamethox	Nitrofurantoin
Achromobacter xylosoxidans	29(c)	–	–	90	–	–	14	0	86	69	–	0	0	7	17	66	83	–
Acinetobacter baumannii	20(c)	–	90	–	–	–	70	–	–	80	–	85	85	95	70	75	75	–
Burkholderia cepacia complex (d)	10(c)	Ceftazidime 90%			–	Minocycline 80			–	70	–	–	–	–	–	–	63	–
Citrobacter freundii complex	111	0	0	84	0	76	88	58	92	98	96	93	93	100	95	93	81	94
Citrobacter koseri	87	0	96	99	97	99	100	100	100	100	100	100	99	100	100	98	97	77
Enterobacter cloacae complex	228	0	0	81	0	76	97	78	98	99	89	97	97	99	96	97	94	35
Escherichia coli	3598	49	51	95	82	88	83	83	100	100	100	89	88	100	77	77	69	96
Klebsiella aerogenes (e)	93	0	0	77	0	73	98	73	82	99	95	100	100	100	99	98	99	9
Klebsiella oxytoca	172	0	71	94	52	91	94	91	99	99	99	95	92	99	94	97	84	72
Klebsiella pneumoniae	786	0	76	92	87	90	89	87	100	99	99	94	94	100	92	94	84	20
Morganella morganii	63	0	0	100	0	92	100	96	–	100	100	78	92	98	79	89	64	0
Proteus mirabilis	345	75	76	100	87	94	93	96	–	100	100	86	88	99	84	85	75	0
Proteus vulgaris	11(c)	0	–	100	0	–	100	–	–	100	100	100	100	100	100	100	100	0
Pseudomonas aeruginosa	580	–	–	93	–	–	92	86	88	91	–	91	98	97	89	85	–	–
Ps. aeruginosa CF mucoid (d)	165	–	–	89	C/T 96%		81	84	79	84	–	–	95	73	76	61	–	–
Ps. aeruginosa CF non-mucoid (d)	109	–	–	72	C/T 92%		72	72	63	75	–	–	79	47	55	28	–	–
Salmonella spp.	27(c)	89	–	–	–	96	–	–	–	–	–	–	–	–	85	–	93	–
Serratia marcescens	125	0	0	97	0	95	100	100	100	100	100	100	97	100	96	98	98	0
Stenotrophomonas maltophilia	92	–	–	–	–	–	–	–	–	–	–	–	–	–	–	86	99	–
Cost		$$	$	$$	$	$	$	$$$	$$$	$$	$$	$	$	$	$	$	$	$

C/T= Ceftolozane/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) 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 Cephems (c)	Vancomycin	Erythromycin	Clindamycin (d)	Gentamicin	Trimeth/Sulfa	Moxifloxacin	Tetracycline (Doxy)	Linezolid
Staphylococcus aureus, ALL(b)	1772	(a)	78	78	100	58	74	96	99	74	95	100
MRSA (ONLY) (c)	383	0	0	0	100	10	55	93	97	23	94	100
MSSA (ONLY)	1389	(a)	100	100	100	71	79	97	100	86	95	100
Staph. lugdunensis	108	(a)	97	97	100	84	86	98	99	100	91	100
Staph. coagulase negative (other)	296	(a)	43	43	100	33	61	80	61	56	81	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, 65% of H. influenzae (n=104) are ampicillin susceptible.

(a) Penicillin sensitivity confirmed by PCR 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 μg/ml, currenlty interpreted sensitive, is associated with increased treatment failure.
(c) Oxacillin resistant staphylococci (MRSA & MRSE) should be considered resistant to all penicillins, cephalosporins (except anti-MRSA cephalosporins), imipenem and beta-lactams including combinations with clavulanic acid, sulbactam 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/sulbactam	Pip/tazobactam	Meropenem	Clindamycin	Metronidazole
Bacteroides fragilis	31	0	94	–	94	57	100
Bacteroides sp. NOT fragilis	36	0	69	–	97	31	97
Gram negative rods (other) (b)	31	55	100	–	100	65	100
Clostridium perfringens	13	100	100	–	100	23	100
Clostridium sp. NOT perfringens	32	56	94	–	100	52	97
Gram positive rods (other) (c)	28	93	100	–	96	75	15
Gram positive cocci	32	100	100	–	100	66(d)	100
Cost ($)		$	$	$$	$$	$$	$

(a) Not all isolates tested with every drug
(b) Include Fusobacterium, Prevotella, Porphyromonas, & other.
c) Non-sporeforming rods include Actinomyces, Bifidobacterium, Lactobacillus, Cutibacterium, and others.
(d) Notify Micro Lab to perform antibiotic susceptibility testing if clindamycin is being considered for a Peptostreptococcus.
(e) <30 isolates may be statistically unreliable

Campylobacter sp. (n = 49)	
Drug	%Susceptible
Ciprofloxacin	61
Doxycycline	55
Erythromycin	98

M. tuberculosis (n = 23)	
Drug (mcg/mL)	%Susceptible
Isoniazid (0.1)	83
Rifampin (1)	100
Ethambutol (5)	100
Pyrazinamide (100)	96