

NATIONWIDE CHILDREN'S HOSPITAL
ANTIMICROBIAL SUSCEPTIBILITY PROFILE (PERCENT SUSCEPTIBLE)
2020 THROUGH 2024 CUMULATIVE DATA ¹

**ANAEROBIC BACTERIA
INCLUDES ALL PATIENTS**

ANAEROBES	Organisms	# Isolates ²	Beta-lactam and combinations			Carba- penem	Others	
			Penicillin	Ampicillin/ sulbactam	Piperacillin/ tazobactam	Meropenem	Clindamycin	Metronidazole
	Gram Negative Organisms							
	<i>Bacteroides fragilis</i> group ³	91	R	86	86	100	36	98
	<i>Fusobacterium</i> spp.	41		100	100	100	98	100
	<i>Prevotella</i> spp.	42		100	100	98	45	88
	Gram Positive Organisms							
	Anaerobic gram-positive cocci ⁴	19	89	100	94	100	63	89
	<i>Clostridium</i> spp.	35	77	100	100	100	47	100
	<i>Cutibacterium (Propionibacterium) acnes</i> ⁵	27	96	100	100	100	96	R

R= Intrinsic resistance

1. This represents five calendar years of data.
2. Percentage susceptible based on fewer than 30 isolates have lower statistical validity.
3. *Bacteroides fragilis* group includes: *B. fragilis*, *P. distasonis*, *B. ovatus*, *B. thetaiotaomicron*, and *B. vulgatus*.
4. Anaerobic gram-positive cocci include: *Peptococcus*, *Peptostreptococcus*, *Finegoldia*, *Peptoniphilus*, and *Anaerococcus* species.
5. *Cutibacterium (Propionibacterium) acnes* isolates from 2023-2024 only.

NOTE: Ampicillin/sulbactam, piperacillin/tazobactam, or meropenem are the most active agents against anaerobic bacteria. Metronidazole is also generally active EXCEPT for all strains of *Cutibacterium* spp. (formerly *Propionibacterium* spp.) and some strains of anaerobic Gram positive cocci (*Peptostreptococcus* spp., etc.). Contact the Microbiology Lab to request specific susceptibility testing against anaerobic bacteria when treating serious, deep-seated infections.

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**CANDIDA SPECIES
INCLUDES ALL PATIENTS**

Yeast	Organisms ² (Organisms tested were primarily from sterile body sites; such isolates are routinely tested, others tested on request only)	# Isolates ³	Polyenes	Echinocandins	Azoles		
			Amphotericin B ⁴ (MIC ≤1)	Micafungin	Fluconazole		Voriconazole
					%S	%SDD	
	<i>Candida albicans</i>	66	100	100	99	1	98
	<i>Candida glabrata</i>	18	100	94	— ⁵	83	
	<i>Candida krusei</i> ⁶	8	X	X	R		X
	<i>Candida parapsilosis</i>	19	100	100	95	0	94
	<i>Candida tropicalis</i>	15	100	100	87	7	47

R= Intrinsic resistance

- This represents two calendar years of data.
- The following yeasts have no associated CLSI breakpoints: ***C. dubliniensis* and *C. lusitaniae***.
C. dubliniensis may develop resistance to fluconazole and other azoles during therapy.
C. lusitaniae- Amphotericin B should not be used to treat infections due to *Candida lusitaniae* because treatment failure may occur even when the organism is susceptible by in vitro test methods.
- Percentage susceptible based on fewer than 30 isolates have lower statistical validity.
- There are no CLSI breakpoints to categorize *Candida* spp. as S, I, or R to Amphotericin B.
- C. glabrata*** may be moderately susceptible or resistant to fluconazole on initial isolation, may develop resistance during therapy, and may have decreased susceptibility to other azoles. When an isolate is identified as *C. glabrata* and the fluconazole MIC is ≤32, it should be considered if fluconazole is appropriate in the specific clinical context. Expert consultation on selection of a maximum dosage regimen may be useful.
- C. krusei***: 5 calendar years of data 2020-2024 (13 isolates): percent susceptible - amphotericin B MIC ≤1 83%, micafungin 100% and voriconazole 67%.

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**GRAM POSITIVE COCCI
OUTPATIENTS**

GRAM POSITIVE COCCI	Organisms	# Isolates ¹	Penicillins					Cephalo- sporins		Others							Urine Only	
			Ampicillin	Amoxicillin	Amox/Clav	Penicillin G ^{2,3} (IV)	Nafcillin	Cefazolin (1 st generation)	Ceftiaxone (3 rd generation)	Gentamicin ⁴	Doxycycline	Rifampin ⁵	Clindamycin	Erythromycin ⁶	Trimeth/Sulfa	Linezolid	Vancomycin	Nitrofurantoin
	<i>Staphylococcus aureus</i>	2256			71		71	71		98	99	100	77 ⁷	53	92	100	100	100
	<i>Staphylococcus aureus</i> Methicillin resistant (MRSA)	655			0		0	0		98	98	100	76 ⁷	23	87	100	100	100
	<i>Staphylococcus aureus</i> Methicillin susceptible (MSSA)	1601			100		100	100		98	99	100	77 ⁷	65	93	100	100	100
	Coagulase negative Staphylococci (Non-urine isolates)	130			47		47	47		95	84	99	65	36	78	100	100	
	<i>Staph. lugdunensis</i>	52			98		98	98		100	100	100	88	87	100	100	100	
	<i>Enterococcus faecalis</i>	334	100					R	R	R			R		R	100	100	99
	<i>Enterococcus faecium</i> ⁸	17	47					R	R	R			R		R	100	82	47
	<i>Streptococcus anginosus</i> group	47	98			100			100				86				100	
	<i>Streptococcus pneumoniae</i> (All sites)	163		93		98			98				91	61	77			
	<i>Streptococcus pneumoniae</i> (Respiratory sites – including ear, sinus, mastoid)	142		93		98			97				91	62	75			
	<i>Viridans</i> group <i>Streptococcus</i> spp.	36	68				58			79				92				100

R = Intrinsic resistance

1. Percentage susceptible based on fewer than 30 isolates have lower statistical validity.

2. Penicillin G (IV) and amoxicillin are more active than cefpodoxime, cefixime and cefdinir against *S. pneumoniae*; do not assume that an isolate of *S. pneumoniae* that is susceptible to penicillin G (IV) or amoxicillin is susceptible to these cephalosporins.

3. *S. pneumoniae* non-central nervous system isolates with penicillin MICs <= 0.06 µg/mL are predictably susceptible to ampicillin, ampicillin-sulbactam, amoxicillin, amoxicillin-clavulanate, cefdinir, cefepime, cefotaxime, cefpodoxime, ceftaroline, ceftriaxone, cefuroxime, ertapenem, imipenem and meropenem.

4. Gentamicin is used only in combination with other active agents that test susceptible.

5. Rifampin should not be used as monotherapy due to rapid development of resistance.

6. Erythromycin susceptibility can be used to predict azithromycin susceptibility.

7. Clindamycin resistance-**All SA**: 7% frankly resistant (R), 16% inducible resistance (ICR), **MRSA**: 16% R, 8% ICR, **MSSA**: 3% R, 20% ICR.

8. This represents 2 calendar years of data 2023-2024.

NOTE: Group A streptococci are predictably susceptible to penicillins and cephalosporins. In patients who are allergic to these antibiotics, contact the Microbiology Lab to request susceptibility testing to alternative agents such as clindamycin and erythromycin because about 23% are resistant to the macrolides (erythromycin, azithromycin, clarithromycin) and 17% to clindamycin (NCH Lab data, 2022).

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**ENTERIC PATHOGENS AND NONFERMENTATIVE GRAM NEGATIVE RODS
OUTPATIENTS**

NONFERMENTATIVE GRAM NEGATIVE RODS	Organisms	# Isolates ¹	Penicillins			Cephalosporins				Aminoglycosides			Others						
			Amp/Subactam	Ampicillin	Piperacillin/ Tazobactam	Ceftriaxone (3 rd generation)	Ceftazidime (3 rd generation)	Cefepime (4 th generation)	Ceftolozane/ tazobactam	Gentamicin	Tobramycin	Amikacin	Azithromycin	Trimeth/Sulfa	Meropenem	Aztreonam	Levofloxacin	Ciprofloxacin	Minocycline
	<i>Acinetobacter baumannii</i> complex	29	93	R	83		100	93		86	86	100		93	96	R		93	96
	<i>Achromobacter xylosoxidans/denitrificans</i>	53			100		83							89	96			35	92
	<i>Ps. aeruginosa</i> (excluding- complex respiratory and CF)	442	R	R	96	R	97	94	99		92			R	96			82	
	<i>Ps. aeruginosa</i> (complex respiratory, including CF)	209	R	R	81	R	86	70			50			R	86	80	50	64	
	<i>Stenotroph. maltophilia</i>	94	R	R	R	R				R	R	R		96	R	R	80		94
ENTERIC PATHOGENS ²	<i>Aeromonas</i> spp.	13		R		100							90				100		
	<i>Plesiomonas shigelloides</i> ³	6		R		X							X				X		
	<i>Salmonella</i> spp.	87		91		98							99				85		
	<i>Shigella</i> spp. ⁴	17		24		88						100	65				76		
	<i>Yersinia enterocolitica</i> ⁵	7		R		X							X				X		

R = Intrinsic resistance

1. Percentage susceptible based on fewer than 30 isolates have lower statistical validity.

2. Inpatient and outpatient data combined for enteric pathogens.

3. *Plesiomonas shigelloides*: 5 calendar years of data 2020-2024 (11 isolates): percent susceptible -ceftriaxone 100%, ciprofloxacin 91%, and trimethoprim/sulfamethoxazole 82%.

4. *Shigella* spp.: 5 calendar years of data 2020-2024 (54 isolates): percent susceptible - ampicillin 35%, ceftriaxone 89%, ciprofloxacin 78% and trimethoprim/sulfamethoxazole 39%.

5. *Yersinia enterocolitica*: 5 calendar years of data 2020-2024 (36 isolates): percent susceptible - ceftriaxone 94%, ciprofloxacin 100%, and trimethoprim/sulfamethoxazole 100%.

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**ENTERIC GRAM NEGATIVE ROD- URINE ISOLATES
OUTPATIENTS**

URINE ENTERIC GRAM NEGATIVE RODS	Organisms	# Isolates ¹	Penicillins			Cephalosporins				Amino- glycosides	Others		
			Ampicillin	Piperacillin/ Tazobactam	Amox/Clav	Ceftriaxone (3 rd generation)	Cefazolin ² (1 st generation)	Cefpodoxime (3 rd generation)	ESBL % negative ³	Gentamicin	Trimeth/Sulfa	Ciprofloxacin	Nitrofurantoin
	<i>Citrobacter freundii</i> complex ⁴	33	R	82	R	82	R			88	73	91	91
	<i>Citrobacter koseri</i> ⁵	49	R	98		100	100	100		96	98	96	84
	<i>Enterobacter cloacae</i> complex	38	R	84	R	89	R			100	92	95	26
	<i>Escherichia coli</i>	2309	56	93	84	96	93	94	96	91	77	87	98
	<i>Klebsiella (Enterobacter) aerogenes</i>	34	R	82	R	85	R			97	100	97	15
	<i>Klebsiella oxytoca</i>	43	R	95	93	93	79	95	X	93	88	93	77
	<i>Klebsiella pneumoniae</i>	192	R	84	87	90	89	90	90	95	82	88	28
	<i>Morganella morganii</i> ⁵	47	R	96	R	81	R			87	81	79	R
	<i>Proteus mirabilis</i>	152	89	99	99	99	96	99	X	96	89	93	R
	<i>Proteus</i> spp. (not <i>P. mirabilis</i>) ⁵	27	R	96		89	R			93	85	93	R
	<i>Providencia</i> spp. ⁵	31	R	94	R	94	R			R ⁶	74	81	R
	<i>Serratia marcescens</i> ⁵	36	R	100	R	92	R			94	100	89	R

R = Intrinsic resistance

1. Percentage susceptible based on fewer than 30 isolates have lower statistical validity.

2. Cefazolin susceptibility test results may be used to predict susceptibility to cefdinir, cefuroxime axetil, and cephalexin when used for therapy of uncomplicated UTIs due to *E. coli*, *K. pneumoniae*, and *P. mirabilis*.

3. *E. coli*, *K. oxytoca*, *K. pneumoniae*, and *P. mirabilis* isolates testing non-susceptible to third generation cephalosporins are screened for ESBL production.

4. *Citrobacter freundii* complex includes: *C. braakii*, *C. freundii*, *C. gillenii*, *C. murlinae*, *C. rodentium*, *C. sedlakii*, *C. werkmanii* and *C. youngae*.

5. This represents 2 calendar years of data 2023-2024.

6. *Providencia stuartii* should be considered resistant to gentamicin and tobramycin but not intrinsically resistant to amikacin. Other *Providencia* spp. may test susceptible.

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**ENTERIC GRAM NEGATIVE RODS- NON URINE
OUTPATIENTS**

NON URINE ENTERIC GRAM NEGATIVE RODS	Organisms	# Isolates ¹	Penicillins			Cephalosporins				Aminoglycosides			Others		
			Ampicillin	Ampicillin/ sulbactam	Piperacillin/ Tazobactam	Ceftioxone (3 rd generation)	Ceftazidime (3 rd generation)	Cefepime (4 th generation)	ESBL % negative ²	Gentamicin	Tobramycin	Amikacin	Trimeth/Sulfa	Meropenem	Ciprofloxacin
	<i>Citrobacter freundii</i> complex ^{3,4}	28	R	R	92	100	100	100		93	82	93	86	100	79
	<i>Citrobacter koseri</i> ⁴	20	R		75	80	80	90		75	75	85	90	100	90
	<i>Enterobacter cloacae</i> complex	57	R	R	89	91	93	100		95	93	96	93	100	96
	<i>Escherichia coli</i>	107	36	42	82	83	84	87	87	82	81	92	70	100	63
	<i>Klebsiella (Enterobacter) aerogenes</i> ⁴	21	R	R	95	95	95	100		90	90	100	100	100	95
	<i>Klebsiella oxytoca</i>	52	R	85	94	96	98	98	X	96	96	100	94	100	98
	<i>Klebsiella pneumoniae</i>	49	R	69	80	84	84	84	86	76	76	94	71	100	76
	<i>Morganella morganii</i> ⁴	13	R	15	100	92	92	100		77	85	100	85	100	85
	<i>Proteus mirabilis</i>	42	83	90	95	95	95	95	X	81	83	95	81	100	83
	<i>Proteus</i> spp. (not <i>P. mirabilis</i>) ⁴	7	R	X	X	X	X	X		X	X	X	X	100	X
	<i>Providencia</i> spp. ⁴	20	R	65	100	100	95	100		R ⁵	R ⁵	100	85	100	75
	<i>Serratia marcescens</i>	81	R	R	94	95	98	100		79	64	85	98	100	91

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2. *E. coli*, *K. oxytoca*, *K. pneumoniae*, and *P. mirabilis* isolates testing non-susceptible to third generation cephalosporins are screened for ESBL production.

3. *Citrobacter freundii* complex includes: *C. braakii*, *C. freundii*, *C. gillenii*, *C. murlinae*, *C. rodentium*, *C. sedlakii*, *C. werkmanii*, and *C. youngae*.

4. This represents 2 calendar years of data 2023-2024.

5. *Providencia stuartii* should be considered resistant to gentamicin and tobramycin but not intrinsically resistant to amikacin. Other *Providencia* spp. may test susceptible.

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**HAEMOPHILUS INFLUENZAE
OUTPATIENTS**

Organism	# Isolates	% Beta lactamase negative ¹
<i>Haemophilus influenzae</i>	209	72

1. Most Beta lactamase negative isolates are susceptible to ampicillin, amoxicillin and related compounds

SUSCEPTIBILITY TEST INTERPRETATION

S = Susceptible in serum and urine to oral doses of the antibiotic, or to recommended parenteral doses if the antibiotic is not given orally.

R = Resistant to the antibiotic by any route of administration.

I = Intermediate: This category implies that response rates may be lower than that of susceptible isolates with achievable drug levels in blood and tissue. Consult Pharmacy or Infectious Diseases (ext. 5-0221) for appropriate dosing.

SDD = Susceptible dose dependent. This category implies that the susceptibility of an isolate is dependent on the dosing regimen that is used in the patient. Consult Pharmacy or Infectious Diseases (ext. 5-0221) for appropriate dosing.

X = Percentage susceptible not calculated for organisms with less than 10 isolates.

Breakpoint revisions¹ for the following organism/antibiotic combinations:

Data included in the 2024 antibiogram reflects these revisions.

Organism	Antibiotic	Old breakpoints	Revised breakpoints	Breakpoint implementation date
<i>Stenotrophomonas maltophilia</i>	Ceftazidime Minocycline	M100 Ed-33 ≤8 16 ≥32 ≤4 8 ≥16	M100 Ed-34 removed ≤1 2 ≥4	01/28/2025
<i>Acinetobacter baumannii</i> complex	Minocycline	M100 Ed-34 ≤4 8 ≥16	M100 Ed-35 ≤1 2 ≥4	Pending implementation
<i>Burkholderia cepacia</i> complex	M100 Ed-35 All antibiotic breakpoints removed Antimicrobial susceptibility testing for <i>B. cepacia</i> complex is not routinely performed due to the lack of accurate test methods. For assistance with treatment, contact Infectious Diseases.			Pending implementation

1. CLSI Performance Standards for Antimicrobial Susceptibility Testing. 35th Ed. 2025

Please direct any questions regarding susceptibility testing and reporting to Dr. Amy Leber (ext. 2-5445), Dr. Sophonie Oyeniran (ext.2-4878), Dr. Huanyu Wang (ext. 2-1540) or consult Infectious Diseases (ext. 5-0221).