2009 ANTIBIOGRAM

University of Alberta Hospital and the Stollery Childrens' Hospital

Division of Medical Microbiology
Department of Laboratory Medicine and Pathology

Table of Contents

Introduction

The antibiogram is an annual cumulative report of the antimicrobial susceptibility rates of common microbial pathogens to antimicrobials available on the hospital formulary. This report represents the local microbial epidemiology of the University of Alberta (UAH), Stollery Childrens' Hospital, and the Cross Cancer Institute (CCI), and is intended to be used as a guideline to direct empiric antimicrobial therapy.

Antibiograms are generated by the compilation of susceptibility results from all 'first' clinical isolates of a specific pathogen recovered from an individual patient per calendar year. That is, only the first isolate within a 14-day period, regardless of specimen type or body site, is selected for analysis. The rationale for this referral period is based on the need to represent 'wild-type' susceptibility profiles and avoid over-representing antimicrobial resistance that may develop *de novo* during a patient's prolonged hospital stay. Susceptibility rates for patient groups (ie. age or ward location) represented by less than 30 isolates of a pathogen were not calculated due to the limited statistical relevance; in fact, rates derived from less than 30 isolates are of limited statistical value and should be interpreted carefully.

This antibiogram handbook contains summary data for 2009 and notable resistance trends over the past several years.

A tremendous amount of effort goes into the creation of this document each year and the effort of the entire medical microbiology technologist staff is truly appreciated. Also, we would like to acknowledge Dr. Darren Hudson, UAH, for taking a lead role in the development of a turnkey electronic approach to the antibiogram data analyses that has significantly improved the time and effort required for the production of this document.

The antibiogram is available in PDF format on the Department of Laboratory Medicine and Pathology websites.
www.capitalhealth.ca/AboutUs/OurOrganization/AreasofService/LaboratoryMedicine/LabMedicine/LaboratoryNews/default.htm
www.lmp.ualberta.ca/divisions/microbiology.htm

An online 'app' for reference is also available at http://www.antibiogram.ca/.

Inquiries and feedback may be directed to Dr. Jeff Fuller, Division of Medical Microbiology, at jeff.fuller@albertahealthservices.ca.

Antibiogram Resistance Trends

Enterobacteriaceae:

Enterobacter, Citrobacter, and *Serratia* species may develop resistance to all β-lactams except for imipenem and meropenem during prolonged β-lactam therapy. These pathogens are also intrinsically resistant to ampicillin, cefazolin, and cefuroxime.

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. ESBL-positive *Escherichia coli* isolation rates of <1%, 2.5%, 5.2%, 3.6%, and 5.2% were reported from 2005 to 2009, respectively. A significant proportion of ESBL-positive *E. coli* (2009) were also resistant to other antibiotic classes including the quinolones (82%), aminoglycosides (36%), and trimethoprim-sulfamethoxazole (63%).

Klebsiella ESBL isolation rates of 2.3%, 3.4%, 4.2%, and 2.5% were reported from 2006 to 2009, respectively. Cross-resistance rates to the quinolones, aminoglycosides, and trimethoprim-sulfamethoxazole were 47%, 71%, and 47%, respectively.

***Enterococcus* species:**

Resistance rates in clinically relevant enterococci have not changed significantly over the last five years. However, periodic hospital outbreaks of vancomycin resistant enterococcus (VRE) increase the risk of serious infections with resistant enterococci. Identification of enterococci to the species level is only performed for sterile site isolates but vancomycin resistance is confirmed for ALL enterococcus isolates, regardless of specimen site.

***Pseudomonas aeruginosa*:**

Resistance rates in *P. aeruginosa* have remained relatively unchanged for over five years of surveillance in patients with and without cystic fibrosis and in both adult and pediatric populations. Resistance in 2009 was 15% to ceftazidime, 26% to ciprofloxacin, 23% to gentamicin, 16% to imipenem, and 14% to piperacillin.

***Staphylococcus aureus*:**

Resistance and isolation rates of *S. aureus* (ie. MSSA) have remained relatively stable. However, the prevalence of methicillin-resistant *S.aureus* (MRSA), which are resistant to all β-lactam antibiotics, has increased over the past several years. MRSA strains may be referred to as 'community-associated' (CA) or 'hospital-associated' (HA) that, in the context of this antibiogram, primarily differ based on the degree of non-β-lactam antibiotic resistance. CA-MRSA tend to be more

predictably susceptible to clindamycin, gentamicin, and trimethoprim-sulfamethoxazole than HA-MRSA but this distinction technically requires molecular genotyping that is not routinely available.

The annual isolation rate of MRSA relative to all *S. aureus* from 2004 to 2009 was 4%, 7%, 18%, 25%, 28%, and 20%, respectively. In 2009, 389 (334 Adult, 55 Pediatric) MRSA isolates were identified with susceptibility testing but genotype data was available only for the subset displayed in the table; no linezolid or vancomycin resistance was detected. CA-MRSA resistance to clindamycin has remained at 29% the past two years and resistance to gentamicin, rifampin, and trimethoprim-sulfamethoxazole remained below 5%.

***Streptococcus pneumoniae*:**

As of 2008, penicillin susceptibility interpretations for all pneumococcal isolates are reported in three categories to account for penicillin pharmacodynamics in cases of meningitis, non-meningeal infections, or oral penicillin V therapy; resistance for 2009 was 20%, 0%, and 20%, respectively. Similarly, ceftriaxone rates for meningeal and non-meningeal infections were 2% and 0%, respectively. Note, these rates do not reflect actual cases of pneumococcal meningitis.

Resistance to the macrolides in *S. pneumoniae* is a global problem; Canadian rates have been steadily increasing for the past decade and reached ~25% in 2007. This is mirrored by our hospital rate, which has steadily increased from 14% in 2006 to 29% in 2009. No vancomycin resistance has been detected to date in *S. pneumoniae*. Trimethoprim-sulfamethoxazole resistance has remained stable at ~25% for the last several years and quinolone resistance is rare.

***Candida* species:**

C. albicans and *C. glabrata* comprise more than 80% of all *Candida* isolated from sterile-sites. This has remained unchanged since 2005 when UAH yeast susceptibility results were first published. *C. albicans* are predictably susceptible to most antifungal agents. However, *C. glabrata* exhibit significant resistance to fluconazole (28%), which is consistent with global resistance rates.

Medically Relevant Pathogens Based on Gram Morphology

Gram-negative bacilli		
Lactose Fermenters	**Non-lactose Fermenters**	**Glucose Non-fermenters**
Escherichia coli	*Serratia marcescens*	*Pseudomonas aeruginosa*
Klebsiella pneumoniae	*Proteus mirabilis*	*Pseudomonas* species
Klebsiella oxytoca	*Morganella morganii*	*Stenotrophomonas maltophilia*
Enterobacter cloacae	*Aeromonas* species	*Acinetobacter baumanii* complex
Citrobacter freundii complex	*Providencia rettgeri*	*Achromobacter* species
Enterobacter aerogenes	*Providencia stuartii*	*Burkholderia cepacia*
Citrobacter koseri	*Salmonella species*	*Chryseobacterium* species

Gram-positive Cocci	
Gram-positive Cocci in Chains	**Gram-positive Cocci in Clumps**
Enterococcus species	*Staphylococcus aureus*
Streptococcus species, including:	*Staphylococcus* species, coagulase-negative
Streptococcus pyogenes (Group A)	*Staphylococcus lugdunensis*
Streptococcus agalactiae (Group B)	*Micrococcus* species
Streptococcus pneumoniae	*Aerococcus* species
Viridans group streptococci	*Rothia mucilaginosus*
Streptococcus anginosus group	

Abbreviation Glossary for Antimicrobials

Antimicrobial	Abbreviation	Antimicrobial	Abbreviation
Amikacin	AMK	Gentamicin	GEN
Ampicillin	AMP	Gentamicin Synergy	GM500
Amphotericin B	AMB	Imipenem	IMI
Caspofungin	CASP	Levofloxacin	LEV
Cefazolin	FAZ	Linezolid	LNZ
Ceftriaxone	CRO	Meropenem	MERO
Ceftazidime	CAZ	Nitrofurantoin	NIT
Cefuroxime	CXM	Penicillin	PEN
Ciprofloxacin	CIP	Pipercillin	PIP
Clindamycin	CLIN	Rifampin	RIF
Cloxacillin	CLOX	Tetracycline	TET
Colistin	COL	Ticarcillin-clavulanic acid	TIM
Doxycycline	DOXY	Tobramycin	TOB
Erythromycin	ERY	Trimethoprim-sulfamethoxazole	SXT
Fluconazole	FLUC	Vancomycin	VAN
Flucytosine	5-FC	Voriconazole	VORI

Antibiogram Tables

***Acinetobacter baumanni* complex**							
All Specimen Sources		**CAZ**	**CIP**	**GEN**	**IMI**	**TOB**	**SXT**
ALL Ages	**% SUS**	**91**	**94**	**100**	**100**	**97**	**91**
	# SUS	32	33	35	35	34	32
	# TESTED	35	35	35	35	35	35
≥ 17 years	**% SUS**	**93**	**93**	**100**	**100**	**100**	**93**
	# SUS	27	27	29	29	29	27
	# TESTED	29	29	29	29	29	29

***Burkholderia cepacia* complex**					
All Specimen Sources		**CAZ**	**LEVO**	**MERO**	**SXT**
CF Patients	**% SUS**	**81**	**56**	**67**	**67**
ALL Ages	# SUS	17	9	14	14
	# TESTED	21	16	21	21

***Citrobacter freundii* complex**									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**73**	**89**	**88**	**100**	**97**	**83**
	# SUS	0	0	74	91	90	102	99	85
	# TESTED	102	102	102	102	102	102	102	102
≥ 17 years	**% SUS**	**0**	**0**	**76**	**87**	**87**	**100**	**97**	**84**
	# SUS	0	0	60	69	69	79	77	66
	# TESTED	79	79	79	79	79	79	79	79
< 17 years	**% SUS**	**0**	**0**	**61**	**96**	**91**	**100**	**96**	**83**
	# SUS	0	0	14	22	21	23	22	19
	# TESTED	23	23	23	23	23	23	23	23

Citrobacter koseri									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**93**	**100**	**97**	**100**	**100**	**55**	**97**
	# SUS	0	27	29	28	29	29	16	28
	# TESTED	29	29	29	29	29	29	29	29
≥ 17 years	**% SUS**	**0**	**92**	**100**	**96**	**100**	**100**	**56**	**16**
	# SUS	0	23	25	24	25	25	14	4
	# TESTED	25	25	25	25	25	25	25	25

Enterobacter, Citrobacter, and *Serratia* species may develop resistance to all β-lactams except for imipenem and meropenem during prolonged β-lactam therapy. These pathogens are also intrinsically resistant to ampicillin, cefazolin, and cefuroxime.

Enterobacter aerogenes									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**80**	**98**	**100**	**100**	**9**	**96**
	# SUS	0	0	45	55	56	56	5	54
	# TESTED	56	56	56	56	56	56	56	56
≥ 17 years	**% SUS**	**0**	**0**	**81**	**98**	**100**	**100**	**4**	**96**
	# SUS	0	0	39	47	48	48	2	46
	# TESTED	48	48	48	48	48	48	48	48

Enterobacter cloacae									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**0**	**84**	**93**	**98**	**100**	**24**	**94**
ALL Ages	# SUS	0	0	198	222	236	240	58	225
	# TESTED	240	240	235	240	240	240	240	240
≥ 17 years	**% SUS**	**0**	**0**	**85**	**91**	**98**	**99**	**25**	**95**
	# SUS	0	0	163	180	194	196	49	187
	# TESTED	197	197	192	197	197	197	197	197
< 17 years	**% SUS**	**0**	**0**	**81**	**98**	**98**	**100**	**21**	**88**
	# SUS	0	0	35	42	42	43	9	38
	# TESTED	43	43	43	43	43	43	43	43

Enterobacter, Citrobacter, and *Serratia* species may develop resistance to all β-lactams except for imipenem and meropenem during prolonged β-lactam therapy. These pathogens are also intrinsically resistant to ampicillin, cefazolin, and cefuroxime.

Escherichia coli									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**50**	**84**	**92**	**71**	**91**	**100**	**95**	**70**
ALL Ages	# SUS	1137	1899	2033	1603	2054	2263	2148	1592
	# TESTED	2263	2263	2198	2263	2263	2263	2263	2263
	% SUS	**51**	**83**	**92**	**65**	**90**	**100**	**94**	**88**
≥ 17 years	# SUS	921	1500	1610	1182	1630	1809	1707	1592
	# TESTED	1809	1809	1756	1809	1809	1809	1809	1809
	% SUS	**48**	**88**	**96**	**93**	**93**	**100**	**97**	**71**
< 17 years	# SUS	216	399	423	421	424	454	441	322
	# TESTED	454	454	442	454	454	454	454	454
	% SUS	**33**	**63**	**83**	**51**	**90**	**100**	**94**	**60**
UAH 3C3/3C4	# SUS	21	40	50	32	57	63	59	38
	# TESTED	63	63	60	63	63	63	63	63
	% SUS	**60**	**92**	**97**	**77**	**90**	**100**	**95**	**76**
CCI	# SUS	59	90	90	75	88	98	93	74
	# TESTED	98	98	93	98	98	98	98	98

Escherichia coli - **ESBL Producers**									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**18**	**64**	**100**	**88**	**37**
ALL Ages	# SUS	0	0	0	21	75	117	103	43
	# TESTED	117	117	117	117	117	117	117	117
	% SUS	**0**	**0**	**0**	**16**	**67**	**100**	**88**	**38**
≥ 17 years	# SUS	0	0	0	17	70	104	92	39
	# TESTED	104	104	104	104	104	104	104	104

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. ESBL-positive *Escherichia coli* isolation rates of <1%, 2.5%, 5.2%, 3.6%, and 5.2% were reported from 2005 to 2009, respectively. A significant proportion of ESBL-positive *E. coli* (2009) were also resistant to other antibiotic classes including the quinolones (82%), aminoglycosides (36%), and trimethoprim-sulfamethoxazole (63%).

Haemophilus influenzae				
All Specimen Sources		**AMP**	**CXM**	**SXT**
ALL Ages	**% SUS**	**88**	**97**	**79**
	# SUS	229	37	27
	# TESTED	260	38	34
≥ 17 years	**% SUS**	**90**	**96**	**73**
	# SUS	171	23	16
	# TESTED	191	24	22
< 17 years	**% SUS**	**84**	**100**	**92**
	# SUS	58	14	11
	# TESTED	69	14	12

Klebsiella species									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**86**	**96**	**96**	**98**	**100**	**42**	**94**
ALL Ages	# SUS	0	581	627	649	658	673	286	630
	# TESTED	673	673	654	673	673	673	673	673
	% SUS	**0**	**88**	**97**	**96**	**98**	**100**	**40**	**93**
≥ 17 years	# SUS	0	507	542	555	569	578	229	540
	# TESTED	578	578	561	578	578	578	578	578
	% SUS	**0**	**78**	**91**	**99**	**94**	**100**	**60**	**94**
< 17 years	# SUS	0	74	86	94	89	95	57	90
	# TESTED	95	95	95	95	95	95	95	96
	% SUS	**0**	**91**	**98**	**98**	**98**	**100**	**45**	**98**
UAH 3C3/3C4	# SUS	0	40	43	43	43	44	20	43
	# TESTED	44	44	44	44	44	44	44	44
	% SUS	**0**	**94**	**100**	**100**	**100**	**100**	**48**	**100**
CCI	# SUS	0	31	33	33	33	33	16	33
	# TESTED	33	33	33	33	33	33	33	33

Klebsiella species - ESBL Producers									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**53**	**29**	**100**	**41**	**53**
ALL Ages	# SUS	0	0	0	9	5	17	7	9
	# TESTED	17	17	17	17	17	17	17	17

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. *Klebsiella* ESBL isolation rates of 2.3%, 3.4%, 4.2%, and 2.5% were reported from 2006 to 2009, respectively. Cross-resistance rates to the quinolones, aminoglycosides, and trimethoprim-sulfamethoxazole were 47%, 71%, and 47%, respectively.

Morganella morganii									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**93**	**89**	**98**	**100**	**0**	**91**
	# SUS	0	0	40	41	45	46	0	42
	# TESTED	46	46	43	46	46	46	46	46
≥ 17 years	**% SUS**	**0**	**0**	**92**	**90**	**100**	**100**	**0**	**95**
	# SUS	0	0	35	37	41	41	0	39
	# TESTED	41	41	38	41	41	41	41	41

Proteus mirabilis									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**70**	**94**	**99**	**70**	**93**	**100**	**0**	**64**
	# SUS	115	155	155	116	154	165	0	105
	# TESTED	165	165	156	165	165	165	165	165
≥ 17 years	**% SUS**	**70**	**94**	**99**	**69**	**94**	**100**	**0**	**65**
	# SUS	108	145	145	107	145	155	0	100
	# TESTED	155	155	146	155	155	155	155	155

Pseudomonas aeruginosa									
All Specimen Sources		**AMK**	**CAZ**	**CIP**	**GEN**	**IMI**	**MERO**	**PIP**	**TOB**
All Patients	**% SUS**	**79**	**85**	**74**	**77**	**84**	**81**	**86**	**87**
ALL Ages	# SUS	926	1000	867	908	980	427	1016	1028
	# TESTED	1173	1175	1175	1175	1172	524	1175	1175
≥ 17 years	**% SUS**	**80**	**85**	**68**	**79**	**82**	**81**	**87**	**89**
	# SUS	710	757	604	701	730	314	771	789
	# TESTED	889	891	891	891	889	386	891	891
< 17 years	**% SUS**	**76**	**86**	**93**	**73**	**88**	**82**	**86**	**84**
	# SUS	216	243	263	207	250	113	245	239
	# TESTED	284	284	284	284	283	138	284	284
Non-CF Patients	**% SUS**	**95**	**86**	**75**	**91**	**86**	**45**	**90**	**95**
ALL Ages	# SUS	677	612	532	650	613	30	640	678
	# TESTED	713	713	713	713	713	66	713	713
≥17 years	**% SUS**	**95**	**86**	**70**	**92**	**84**	**45**	**90**	**95**
	# SUS	530	477	390	510	469	25	498	528
	# TESTED	556	556	556	556	556	55	556	556
< 17 years	**% SUS**	**94**	**86**	**90**	**89**	**92**	**--**	**90**	**96**
	# SUS	147	135	142	140	144	--	142	150
	# TESTED	157	157	157	157	157	--	157	157
CF Patients	**% SUS**	**54**	**84**	**73**	**56**	**79**	**86**	**81**	**76**
ALL Ages	# SUS	249	388	335	258	367	397	376	350
	# TESTED	462	462	462	462	462	462	462	462
≥ 17 years	**% SUS**	**54**	**84**	**64**	**57**	**78**	**86**	**81**	**78**
	# SUS	180	280	214	191	261	289	273	261
	# TESTED	335	335	335	335	335	335	335	335
< 17 years	**% SUS**	**54**	**85**	**95**	**53**	**83**	**85**	**81**	**70**
	# SUS	69	108	121	67	106	108	103	89
	# TESTED	127	127	127	127	127	127	127	127
UAH 3C3/3C4	**% SUS**	**98**	**80**	**80**	**87**	**91**	**--**	**89**	**91**
	# SUS	45	37	37	40	42	--	41	42
	# TESTED	46	46	46	46	46	--	46	46

Resistance rates in *P. aeruginosa* have remained relatively unchanged for over five years of surveillance in patients with and without cystic fibrosis and in both adult and pediatric populations. Resistance in 2009 was 15% to ceftazidime, 26% to ciprofloxacin, 23% to gentamicin, 16% to imipenem, and 14% to piperacillin.

Serratia marcescens									
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**0**	**94**	**93**	**97**	**99**	**0**	**95**
ALL Ages	# SUS	0	0	102	100	105	107	0	103
	# TESTED	108	108	108	108	108	108	108	108
	% SUS	**0**	**0**	**93**	**94**	**100**	**100**	**0**	**99**
≥ 17 years	# SUS	0	0	79	80	85	85	0	84
	# TESTED	85	85	85	85	85	85	85	85

Enterobacter, *Citrobacter*, and *Serratia* species may develop resistance to all β-lactams except for imipenem and meropenem during prolonged β-lactam therapy. These pathogens are also intrinsically resistant to ampicillin, cefazolin, and cefuroxime.

Stenotrophomonas maltophilia				
All Specimen Sources		**DOXY**	**TIM**	**SXT**
All Patients	**% SUS**	**79**	**29**	**93**
ALL Ages	# SUS	202	75	238
	# TESTED	255	255	255
	% SUS	**75**	**30**	**91**
≥ 17 years	# SUS	132	53	160
	# TESTED	175	175	175
	% SUS	**88**	**28**	**98**
< 17 years	# SUS	70	22	78
	# TESTED	80	80	80

Enterococcus species							
All Specimen Sources		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT**	**VAN**
All Patients	**% SUS**	**87**	**54**	**68**	**97**	**90**	**99**
ALL Ages	# SUS	1365	845	1062	1483	1392	1596
	# TESTED	1562	1551	1555	1524	1548	1607
	% SUS	**86**	**46**	**64**	**97**	**89**	**99**
≥ 17 years	# SUS	1096	585	815	1215	1126	1308
	# TESTED	1279	1271	1273	1250	1268	1319
	% SUS	**95**	**93**	**88**	**98**	**95**	**100**
< 17 years	# SUS	269	260	247	268	266	288
	# TESTED	283	280	282	274	280	288
	% SUS	**77**	**43**	**67**	**100**	**83**	**99**
UAH 3C3/3C4	# SUS	58	32	50	75	62	74
	# TESTED	75	75	75	75	75	75
	% SUS	**79**	**41**	**62**	**94**	**85**	**100**
CCI	# SUS	62	32	48	73	66	78
	# TESTED	78	78	78	78	78	78

Enterococcus faecalis							
Blood specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT**	**VAN**
	% SUS	**100**	**62**	**61**	**100**	**100**	**100**
ALL Ages	# SUS	44	26	27	42	42	44
	# TESTED	44	42	44	42	42	44

Enterococcus faecium							
Blood specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT**	**VAN**
	% SUS	**4**	**4**	**64**	**100**	**29**	**96**
ALL Ages	# SUS	1	1	16	24	7	24
	# TESTED	25	24	25	24	24	25

Resistance rates in clinically relevant enterococci have not changed significantly over the last five years. However, periodic hospital outbreaks of vancomycin resistant enterococcus (VRE) increase the risk of serious infections with resistant enterococci. Identification of enterococci to the species level is only performed for sterile site isolates but vancomycin resistance is confirmed for ALL enterococcus isolates, regardless of specimen site.

Staphylococcus aureus - **MSSA**												
All Specimen Sources		**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**RIF**	**SXT**	**TET**	**VAN**
All Patients	**% SUS**	**92**	**82**	**100**	**80**	**96**	**100**	**98**	**100**	**97**	**96**	**100**
ALL Ages	# SUS	1443	1294	1572	1250	1506	1562	1528	1561	1511	1515	1568
	# TESTED	1562	1571	1572	1571	1563	1562	1564	1564	1564	1571	1568
	% SUS	**91**	**83**	**100**	**80**	**96**	**100**	**98**	**100**	**97**	**97**	**100**
≥ 17 years	# SUS	1072	985	1184	952	1134	1175	1149	1175	1137	1152	1181
	# TESTED	1175	1184	1184	1184	1176	1175	1177	1177	1177	1184	1181
	% SUS	**96**	**80**	**100**	**77**	**96**	**100**	**98**	**100**	**97**	**94**	**100**
< 17 years	# SUS	371	309	388	298	372	387	379	386	374	363	387
	# TESTED	387	387	388	387	387	387	387	387	387	387	387
	% SUS	**94**	**87**	**100**	**85**	**99**	**100**	**100**	**100**	**97**	**99**	**100**
UAH 3C3/3C4	# SUS	101	93	107	91	106	107	107	107	104	106	107
	# TESTED	107	107	107	107	107	107	107	107	107	107	107
	% SUS	**97**	**67**	**100**	**67**	**100**	**100**	**100**	**100**	**97**	**100**	**100**
UAH 3C2	# SUS	29	20	30	20	30	30	30	30	29	30	30
	# TESTED	30	30	30	30	30	30	30	30	30	30	30
	% SUS	**95**	**85**	**100**	**85**	**100**	**100**	**100**	**100**	**98**	**100**	**100**
CCI	# SUS	63	56	66	56	66	66	66	66	65	66	66
	# TESTED	66	66	66	66	66	66	66	66	66	66	66

Staphylococcus aureus - **MRSA**												
All Specimen Sources		**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**RIF**	**SXT**	**TET**	**VAN**
Community-associated	**% SUS**	**17**	**71**	**0**	**21**	**98**	**100**	**98**	**99**	**97**	**98**	**100**
	# SUS	22	91	0	27	126	128	126	127	124	125	128
	# TESTED	128	128	128	128	128	128	128	128	128	128	128
Hospital-associated	**% SUS**	**0**	**4**	**0**	**0**	**52**	**100**	**100**	**100**	**54**	**54**	**100**
	# SUS	0	2	0	0	26	50	50	50	27	27	50
	# TESTED	50	50	50	50	50	50	50	50	50	50	50

Resistance and isolation rates of *S. aureus* (ie. MSSA) have remained relatively stable. However, the prevalence of methicillin-resistant *S.aureus* (MRSA), which are resistant to all β-lactam antibiotics, has increased over the past several years. MRSA strains may be referred to as 'community-associated' (CA) or 'hospital-associated' (HA) that, in the context of this antibiogram, primarily differ based on the degree of non-β-lactam antibiotic resistance. CA-MRSA tend to be more predictably susceptible to clindamycin, gentamicin, and trimethoprim-sulfamethoxazole than HA-MRSA but this distinction technically requires molecular genotyping that is not routinely available.

The annual isolation rate of MRSA relative to all *S. aureus* from 2004 to 2009 was 4%, 7%, 18%, 25%, 28%, and 20%, respectively. In 2009, 389 (334 Adult, 55 Pediatric) MRSA isolates were identified with susceptibility testing but genotype data was available only for the subset displayed in the table; no linezolid or vancomycin resistance was detected. CA-MRSA resistance to clindamycin has remained at 29% the past two years and resistance to gentamicin, rifampin, and trimethoprim-sulfamethoxazole remained below 5%.

***Staphylococcus* species, coagulase-negative**											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
All Patients	**% SUS**	**41**	**48**	**47**	**42**	**36**	**75**	**99**	**16**	**63**	**100**
ALL Ages	# SUS	138	161	162	142	125	251	331	57	217	345
	# TESTED	334	336	344	341	343	334	335	347	343	345
≥ 17 years old	**% SUS**	**40**	**43**	**47**	**40**	**36**	**75**	**99**	**16**	**63**	**100**
	# SUS	110	120	134	114	102	206	273	47	180	287
	# TESTED	278	278	286	284	285	276	277	289	285	287
< 17 years old	**% SUS**	**50**	**71**	**48**	**49**	**40**	**78**	**100**	**17**	**64**	**100**
	# SUS	28	41	28	28	23	45	58	10	37	58
	# TESTED	56	58	58	57	58	58	58	58	58	58

Staphylococcus lugdunensis											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
ALL Ages	**% SUS**	**100**	**100**	**83**	**100**	**78**	**100**	**100**	**75**	**100**	**100**
	# SUS	72	72	60	72	56	72	72	54	72	72
	# TESTED	72	72	72	72	72	72	72	72	72	72
≥ 17 years	**% SUS**	**100**	**100**	**84**	**100**	**78**	**100**	**100**	**75**	**100**	**100**
	# SUS	68	68	57	68	53	68	68	51	68	68
	# TESTED	68	68	68	68	68	68	68	68	68	68

Viridans Group Streptococci				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**97**	**71**	**100**
	# SUS	115	85	119
	# TESTED	119	119	119
≥ 17 years	**% SUS**	**98**	**77**	**100**
	# SUS	88	69	90
	# TESTED	90	90	90
< 17 years	**% SUS**	**93**	**55**	**100**
	# SUS	27	16	29
	# TESTED	29	29	29

***Streptococcus anginosis* group**				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**100**	**99**	**100**
	# SUS	153	152	153
	# TESTED	153	153	153

Streptococcus pneumoniae		M	NM				M	NM	PO		
All Specimen Sources		**CRO**	**CRO**	**DOXY**	**ERY**	**LEV**	**PEN**	**PEN**	**PEN**	**SXT**	**VAN**
All Patients	**% SUS**	**98**	**100**	**80**	**71**	**99**	**80**	**100**	**80**	**73**	**100**
ALL Ages	# SUS	107	109	131	126	201	175	218	175	130	213
	# TESTED	109	109	163	178	203	219	219	219	178	213
	% SUS	**98**	**100**	**80**	**73**	**99**	**82**	**100**	**82**	**74**	**100**
≥ 17 years old	# SUS	65	66	94	87	141	120	147	120	89	146
	# TESTED	66	66	118	120	143	147	147	147	120	146
	% SUS	**98**	**100**	**82**	**67**	**100**	**76**	**99**	**76**	**71**	**100**
< 17 years old	# SUS	42	43	37	39	60	55	71	55	41	67
	# TESTED	43	43	45	58	60	72	72	72	58	67

M, meningitis; NM, non-meningitis; PO, oral administration.

As of 2008, penicillin susceptibility interpretations for all pneumococcal isolates are reported in three categories to account for penicillin pharmacodynamics in cases of meningitis, non-meningeal infections, or oral penicillin V therapy; resistance for 2009 was 20%, 0%, and 20%, respectively. Similarly, ceftriaxone rates for meningeal and non-meningeal infections were 2% and 0%, respectively. Note, these rates do not reflect actual cases of pneumococcal meningitis.

Resistance to the macrolides in *S. pneumoniae* is a global problem; Canadian rates have been steadily increasing for the past decade and reached ~25% in 2007. This is mirrored by our hospital rate, which has steadily increased from 14% in 2006 to 29% in 2009. No vancomycin resistance has been detected to date in *S. pneumoniae*. Trimethoprim-sulfamethoxazole resistance has remained stable at ~25% for the last several years and quinolone resistance is rare.

Streptococcus pyogenes				
All Specimen Sources		**CLIN**	**ERY**	**PEN**
ALL Ages	**% SUS**	**95**	**95**	**100**
	# SUS	38	38	40
	# TESTED	40	40	40

***Candida* species**							
All Specimen Sources		**AMB**	**5-FC**	**ITRA**	**FLUC**	**VORI**	**CASPO**
C. albicans	**% SUS**	**100**	**98**	**74**	**97**	**99**	**100**
ALL Ages	# SUS	94	92	70	91	93	94
	# TESTED	94	94	94	94	94	94
C. glabrata	**% SUS**	**96**	**98**	**5**	**72**	**92**	**100**
ALL Ages	# SUS	88	90	5	66	85	92
	# TESTED	92	92	92	92	92	92
C. parapsilosis	**% SUS**	**100**	**94**	**50**	**100**	**100**	**100**
ALL Ages	# SUS	18	17	9	18	18	18
	# TESTED	18	18	18	18	18	18
C. tropicalis	**% SUS**	**100**	**100**	**83**	**100**	**100**	**100**
ALL Ages	# SUS	**12**	**12**	**10**	**12**	**12**	**12**
	# TESTED	12	12	12	12	12	12

C. albicans and *C. glabrata* comprise more than 80% of all *Candida* isolated from sterile-sites. This has remained unchanged since 2005 when UAH yeast susceptibility results were first published. *C. albicans* are predictably susceptible to most antifungal agents. However, *C. glabrata* exhibit significant resistance to fluconazole (28%), which is consistent with global resistance rates.