University of Alberta Hospital
Antibiogram for 2007 and 2008

Division of Medical Microbiology
Department of Laboratory Medicine and Pathology

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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 10 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 the years 2008 and 2007, presented in that order. Notable antimicrobial resistance trends are summarized below and are also included as footnotes after appropriate antibiogram tables.

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. In particular, we would like to acknowledge Linda Rosmus, Joyce Rushton, Stacey Vachon, and Sophie Chlebek, for their sizable contributions. Also, we would like to acknowledge Dr. Darren Hudson, UAH, for taking a lead role in the development of 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 below:
http://www.lmp.ualberta.ca/divisions/microbiology.htm
http://www.capitalhealth.ca/AboutUs/OurOrganization/AreasofService/LaboratoryMedicine/LabMedicine/LaboratoryNews/default.htm

A CD-ROM application for handheld electronic devices has also been made available through Dr. Darren Hudson, RADogs Productions Inc., and the kind support of Wyeth. Inquiries and feedback may be directed to Dr. Jeff Fuller, Division of Medical Microbiology, at jeff.fuller@capitalhealth.ca.

2007-2008 Antibiogram Resistance Trends

Enterobacteriaceae:

Enterobacter, *Citrobacter*, and *Serratia* species may develop broad-spectrum β-lactam resistance during prolonged therapy. This resistance phenotype may develop during β-lactam therapy and confers resistance to all β-lactams except for imipenem and meropenem. 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 have increased significantly in the last several years; <1% in 2005, 2.5% in 2006, 5.2% in 2007, and 3.6% in 2008. A significant proportion of ESBL-positive *E. coli* are also resistant to other antibiotic classes including the quinolones (83%), aminoglycosides (43%), and trimethoprim-sulfamethoxazole (68%); 2008 data.

Klebsiella ESBL prevalence also seems to be on the rise with isolation rates of 2.3%, 3.4%, and 4.2% in 2006, 2007, and 2008, respectively. Cross-resistance rates in 2008 to the quinolones, aminoglycosides, and trimethoprim-sulfamethoxazole were 31%, 28%, and 37%, respectively.

***Enterococcus* species:**

Resistance rates in clinically relevant enterococci have not changed significantly over the last four years. However, periodic hospital outbreaks of vancomycin resistant enterococcus (VRE) increase the risk of serious infections with resistant erterococci.

It is important to recognize that identification of enterococci to the species level is only performed for sterile site isolates but vancomycin resistance is confirmed for all clinically relevant isolates, regardless of specimen site. In 2008, resistance to vancomycin was 2%, which included 3 VRE bacteremic episodes and 29 non-sterile site isolates, primarily urine specimens. Similar findings were observed in 2007.

***Pseudomonas aeruginosa*:**

Resistance rates in *P. aeruginosa* have remained relatively unchanged for over four years of surveillance in patients with and without cystic fibrosis and in both adult and pediatric populations. Resistance in 2008 was 14% to ceftazidime, 30% to ciprofloxacin, 27% to gentamicin, 22% to imipenem, and 12% to piperacillin.

***Staphylococcus aureus*:**

Resistance and isolation rates of *S. aureus* (ie. MSSA) remain relatively stable. However, the prevalence of methicillin-resistant *S.aureus* (MRSA) isolates, 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) which, 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-sulphamethoxazole 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 2008 was 4%, 7%, 18%, 25%, and 28%, respectively. In 2008, 529 (470 Adult, 59 Pediatric) MRSA isolates were identified with susceptibility testing but genotype data is available only for the subset displayed in the table; no linezolid resistance and only one isolate with intermediate vancomycin resistance (VISA) were detected. Similarly, 438 (414 Adult, 24 Pediatric) MRSA were identified in 2007 and all were susceptible to linezolid and vancomycin.

CA-MRSA resistance to clindamycin was 12% in 2007 (n=73) and increased to 29% in 2008 (n=100) while resistance to gentamicin and trimethoprim-sulphamethoxazole in 2007-08 remained less than 5%, similar to MSSA.

***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 2008 was 14%, 4%, and 14%, respectively. Similarly, ceftriaxone rates for meningeal and non-meningeal infections were 6% and 2%, 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 increased from 14% in 2006, to 20% in 2007, to 26% in 2008. No vancomycin resistance has been detected to date in *S. pneumoniae*. Trimethoprim-sulphamethoxazole 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 (30%), 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

2008 Antibiogram Tables

***Acinetobacter baumanni* complex**								
All Specimen Sources		**CAZ**	**CIP**	**COL**	**GEN**	**IMI**	**TOB**	**SXT**
ALL Ages	**% SUS**	**64**	**66**	**100**	**71**	**86**	**81**	**72**
	# SUS	35	36	41	38	45	44	39
	# TESTED	54	54	41	53	52	54	54
≥ 17 years	**% SUS**	**64**	**64**	**100**	**71**	**81**	**76**	**71**
	# SUS	25	25	32	28	31	30	28
	# TESTED	39	39	32	39	38	39	39

***Burkholderia cepacia* complex**								
All Specimen Sources		**CAZ**	**CIP**	**GEN**	**IMI**	**MERO**	**PIP**	**SXT**
CF Patients	**% SUS**	**86**	**60**	**6**	**6**	**76**	**73**	**80**
ALL Ages	# SUS	13	9	1	1	10	11	12
	# TESTED	15	15	15	15	15	15	15

***Citrobacter freundii* complex**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**84**	**0**	**86**	**87**	**100**	**92**	**78**
	# SUS	0	0	74	0	76	77	88	81	69
	# TESTED	88	88	88	88	88	88	88	88	88
≥ 17 years	**% SUS**	**0**	**0**	**87**	**1**	**84**	**91**	**100**	**94**	**83**
	# SUS	0	0	62	1	60	65	71	67	59
	# TESTED	71	71	71	71	71	71	71	71	71
< 17 years	**% SUS**	**0**	**0**	**70**	**0**	**94**	**70**	**100**	**82**	**58**
	# SUS	0	0	12	0	16	12	17	14	10
	# TESTED	17	17	17	17	17	17	17	17	17

Citrobacter koseri										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**77**	**100**	**81**	**100**	**100**	**100**	**81**	**100**
	# SUS	0	21	27	22	27	27	27	22	27
	# TESTED	27	27	27	27	27	27	27	27	27
≥ 17 years	**% SUS**	0	73	100	78	100	100	100	78	100
	# SUS	0	17	23	18	23	23	23	18	23
	# TESTED	23	23	23	23	23	23	23	23	23

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

Enterobacter aerogenes										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**84**	**0**	**96**	**100**	**98**	**17**	**98**
	# SUS	0	0	66	0	75	78	75	13	76
	# TESTED	78	78	78	77	78	78	77	76	78
≥ 17 years	**% SUS**	**0**	**0**	**81**	**0**	**95**	**100**	**98**	**15**	**98**
	# SUS	0	0	53	0	62	65	63	9	64
	# TESTED	65	65	65	64	65	65	64	63	65

Enterobacter cloacae										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**0**	**70**	**0**	**89**	**96**	**99**	**29**	**91**
ALL Ages	# SUS	0	0	211	0	270	291	298	87	274
	# TESTED	303	303	302	303	303	303	301	301	301
≥ 17 years	**% SUS**	**0**	**0**	**73**	**0**	**87**	**96**	**99**	**26**	**91**
	# SUS	0	0	169	0	202	223	228	60	211
	# TESTED	232	232	231	232	232	232	230	230	232
< 17 years	**% SUS**	**0**	**0**	**63**	**0**	**98**	**98**	**100**	**39**	**88**
	# SUS	0	0	45	0	70	70	71	28	62
	# TESTED	71	71	71	71	71	71	71	71	71
UAH 3C3/3C4	**% SUS**	**0**	**0**	**69**	**0**	**82**	**95**	**100**	**13**	**91**
	# SUS	0	0	26	0	31	36	38	5	35
	# TESTED	38	38	38	38	38	38	38	38	38

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

Escherichia coli										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**51**	**85**	**94**	**89**	**72**	**90**	**99**	**97**	**69**
ALL Ages	# SUS	1237	2061	2269	2141	1746	2183	2394	2349	1673
	# TESTED	2425	2425	2414	2406	2425	2425	2418	2422	2425
	% SUS	**50**	**84**	**93**	**88**	**66**	**89**	**100**	**97**	**68**
≥ 17 years	# SUS	948	1592	1755	1655	1251	1687	1889	1835	1289
	# TESTED	1895	1895	1887	1881	1895	1895	1889	1892	1895
	% SUS	**52**	**90**	**96**	**95**	**94**	**95**	**99**	**98**	**71**
< 17 years	# SUS	276	477	506	499	498	504	524	519	376
	# TESTED	530	530	527	525	530	530	529	530	530
	% SUS	**50**	**82**	**95**	**88**	**65**	**94**	**100**	**98**	**72**
UAH 3C3/3C4	# SUS	37	60	68	63	47	69	73	71	53
	# TESTED	73	73	72	72	73	73	73	72	73
	% SUS	**46**	**85**	**91**	**87**	**62**	**89**	**100**	**95**	**75**
CCI	# SUS	38	71	76	71	51	74	83	79	62
	# TESTED	83	83	83	82	83	83	83	83	83

***Escherichia coli* - ESBL Producers**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**0**	**17**	**57**	**100**	**91**	**32**
ALL Ages	# SUS	0	0	0	0	15	50	87	79	28
	# TESTED	87	87	87	87	87	87	87	87	87
	% SUS	**0**	**0**	**0**	**0**	**14**	**58**	**100**	**92**	**31**
≥ 17 years	# SUS	0	0	0	0	11	45	77	71	24
	# TESTED	77	77	77	77	77	77	77	77	77

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. ESBL-positive *E. coli* isolation rates have increased significantly in the last several years; <1% in 2005, 2.5% in 2006, 5.2% in 2007, and 3.6% in 2008. A significant number of ESBL *E. coli* are also resistant to other antibiotic classes including quinolones (83%), aminoglycosides (43%), and trimethoprim-sulfamethoxazole (68%); 2008 data.

Haemophilus influenzae					
All Specimen Sources		**AMP**	**CRO**	**CXM**	**SXT**
ALL Ages	**% SUS**	**84**	**100**	**95**	**88**
	# SUS	196	12	45	38
	# TESTED	233	12	47	43
≥ 17 years	**% SUS**	**83**	**100**	**93**	**86**
	# SUS	132	9	29	25
	# TESTED	159	9	31	29
< 17 years	**% SUS**	**86**	**100**	**100**	**92**
	# SUS	64	3	16	13
	# TESTED	74	3	16	14

***Klebsiella* species**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	0	80	95	88	92	96	100	53	90
ALL Ages	# SUS	0	614	724	673	707	737	763	405	691
	# TESTED	768	768	762	765	768	768	763	765	768
	% SUS	**0**	**81**	**96**	**89**	**90**	**97**	**100**	**49**	**91**
≥ 17 years	# SUS	0	505	594	554	562	605	620	304	568
	# TESTED	624	624	619	622	624	624	620	621	624
	% SUS	**0**	**75**	**90**	**83**	**99**	**90**	**100**	**72**	**88**
< 17 years	# SUS	0	108	129	119	143	130	143	104	127
	# TESTED	144	144	143	143	144	144	143	144	144
	% SUS	**0**	**75**	**94**	**83**	**91**	**100**	**100**	**41**	**95**
UAH 3C3/3C4	# SUS	0	44	55	49	54	59	59	24	56
	# TESTED	59	59	59	59	59	59	59	59	59
	% SUS	**0**	**81**	**100**	**90**	**97**	**100**	**100**	**45**	**95**
CCI	# SUS	0	36	43	40	431	44	42	20	42
	# TESTED	44	44	43	44	444	44	42	44	44

***Klebsiella* species - ESBL Producers**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**0**	**69**	**72**	**100**	**72**	**63**
ALL Ages	# SUS	0	0	0	0	23	24	33	24	21
	# TESTED	33	33	33	33	33	33	33	33	33
	% SUS	**0**	**0**	**0**	**0**	**50**	**85**	**100**	**60**	**70**
≥ 17 years	# SUS	0	0	0	0	10	17	20	12	14
	# TESTED	20	20	20	20	20	20	20	20	20

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. *Klebsiella* ESBL prevalence seems to be on the rise with isolation rates of 2.3%, 3.4%, and 4.2% in 2006, 2007, and 2008, respectively. Cross-resistance rates in 2008 to the quinolones, aminoglycosides, and trimethoprim-sulfamethoxazole were 31%, 28%, and 37%, respectively.

Morganella morganii										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**93**	**0**	**81**	**83**	**98**	**0**	**77**
	# SUS	0	0	57	0	49	51	59	0	47
	# TESTED	61	61	61	61	61	61	60	61	61
≥ 17 years	**% SUS**	**0**	**0**	**92**	**0**	**78**	**80**	**100**	**0**	**75**
	# SUS	0	0	48	0	41	42	51	0	39
	# TESTED	52	52	52	52	52	52	51	52	52

Proteus mirabilis										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**78**	**92**	**99**	**99**	**77**	**91**	**99**	**0**	**72**
	# SUS	140	165	177	176	138	163	177	0	129
	# TESTED	179	179	179	178	179	179	179	179	179
≥ 17 years	**% SUS**	**81**	**92**	**98**	**99**	**74**	**92**	**99**	**0**	**74**
	# SUS	125	142	151	151	114	142	152	0	114
	# TESTED	154	154	154	153	154	154	154	154	154
< 17 years	**% SUS**	**64**	**92**	**100**	**100**	**96**	**88**	**100**	**0**	**64**
	# SUS	16	23	25	25	24	22	25	0	16
	# TESTED	25	25	25	25	25	25	25	25	25

Pseudomonas aeruginosa									
All Specimen Sources		**AMK**	**CAZ**	**CIP**	**GEN**	**IMI**	**MERO**	**PIP**	**TOB**
All Patients	**% SUS**	**79**	**86**	**70**	**73**	**78**	**85**	**88**	**88**
	# SUS	850	935	761	794	844	801	957	957
ALL Ages	# TESTED	1076	1087	1087	1087	1082	942	1088	1087
	% SUS	**81**	**87**	**63**	**75**	**76**	**84**	**88**	**89**
≥ 17 years	# SUS	654	711	515	613	617	586	720	727
	# TESTED	807	817	817	817	812	698	818	817
	% SUS	**74**	**84**	**91**	**70**	**85**	**90**	**86**	**85**
< 17 years	# SUS	199	227	246	189	230	220	232	230
	# TESTED	269	270	270	270	270	244	270	270
Non-CF Patients	**% SUS**	**94**	**86**	**66**	**85**	**75**	**84**	**90**	**94**
	# SUS	635	587	451	581	509	452	616	642
ALL Ages	# TESTED	675	683	683	683	678	538	684	683
	% SUS	**93**	**86**	**60**	**84**	**73**	**82**	**89**	**94**
≥17 years	# SUS	510	478	334	467	402	358	496	523
	# TESTED	548	556	556	556	551	437	557	556
	% SUS	**95**	**84**	**91**	**90**	**87**	**94**	**91**	**96**
< 17 years	# SUS	121	107	116	114	110	95	116	122
	# TESTED	127	127	127	127	127	101	127	127
CF Patients	**% SUS**	**55**	**86**	**76**	**54**	**83**	**87**	**85**	**78**
	# SUS	221	347	307	218	335	351	343	315
ALL Ages	# TESTED	401	404	404	404	404	404	404	404
	% SUS	**55**	**88**	**68**	**55**	**83**	**88**	**86**	**80**
≥ 17 years	# SUS	142	230	177	144	217	230	224	209
	# TESTED	259	261	261	261	261	261	261	261
	% SUS	**55**	**84**	**92**	**53**	**83**	**87**	**82**	**76**
< 17 years	# SUS	78	120	132	76	119	124	117	109
	# TESTED	142	143	143	143	143	143	143	143
	% SUS	**90**	**82**	**44**	**75**	**62**	**75**	**82**	**90**
UAH 3C3/3C4	# SUS	77	71	38	65	53	55	72	78
	# TESTED	86	87	87	87	85	73	88	87

Resistance rates in *P. aeruginosa* have remained relatively unchanged for over four years of surveillance in patients with and without cystic fibrosis and in both adult and paediatric populations.

Serratia marcescens										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**90**	**0**	**86**	**98**	**95**	**0**	**98**
	# SUS	0	0	116	0	111	126	122	0	126
	# TESTED	129	129	129	128	129	129	128	129	129
≥ 17 years	**% SUS**	**0**	**0**	**89**	**0**	**85**	**98**	**94**	**0**	**98**
	# SUS	0	0	104	0	99	115	110	0	115
	# TESTED	117	117	117	116	117	117	117	117	117

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

Stenotrophomonas maltophilia				
All Specimen Sources		**DOXY**	**TIM**	**SXT**
All Patients	**% SUS**	**69**	**22**	**96**
ALL Ages	# SUS	200	64	278
	# TESTED	290	290	290
≥ 17 years	**% SUS**	**66**	**26**	**96**
	# SUS	139	55	203
	# TESTED	211	211	211
< 17 years	**% SUS**	**77**	**12**	**98**
	# SUS	61	9	77
	# TESTED	79	79	79
UAH 3C3/3C4	**% SUS**	**70**	**27**	**100**
	# SUS	25	10	36
	# TESTED	36	36	36

***Enterococcus* species**							
All Specimen Sources		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT**	**VAN**
All Patients	**% SUS**	**85**	**38**	**70**	**85**	**82**	**98**
ALL Ages	# SUS	1328	589	1091	1279	1269	1549
	# TESTED	1562	1549	1558	1505	1548	1581
	% SUS	**82**	**32**	**66**	**86**	**80**	**98**
≥ 17 years	# SUS	1025	397	824	1040	993	1245
	# TESTED	1250	1242	1248	1209	1241	1270
	% SUS	**93**	**64**	**89**	**83**	**93**	**99**
< 17 years	# SUS	290	196	276	246	286	308
	# TESTED	312	307	310	296	307	311
	% SUS	**64**	**21**	**74**	**93**	**66**	**95**
UAH 3C3/3C4	# SUS	48	16	56	70	50	75
	# TESTED	75	75	75	75	75	79
	% SUS	**91**	**41**	**71**	**92**	**89**	**98**
CCI	# SUS	61	27	48	62	60	68
	# TESTED	67	67	67	67	67	69

Enterococcus faecalis							
Blood Specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT***	**VAN**
	% SUS	**100**	**53**	**67**	**95**	**97**	**97**
ALL Ages	# SUS	46	24	31	42	44	45
	# TESTED	46	45	46	44	45	46

Enterococcus faecium							
Blood Specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT***	**VAN**
	% SUS	**16**	**8**	**91**	**100**	**8**	**91**
ALL Ages	# SUS	4	2	22	23	2	22
	# TESTED	24	23	24	23	23	24

*, for urninary tract infections only

Resistance rates in enterococci have not changed significantly over the last four years. However, the potential for resistance to vancomycin (VRE) is now a much greater concern. Enterococcal species identification is only performed for sterile site isolates but vancomycin resistance is confirmed for all clinically relevant isolates, regardless of specimen site. In 2008, resistance to vancomycin was 2%, which included 3 VRE bacteremic episodes and 29 non-sterile site isolates, primarily urine specimens. Similar findings were observed in 2007.

***Staphylococcus aureus* - MSSA**												
All Specimen Sources		**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**RIF**	**SXT**	**TET**	**VAN**
All Patients	**% SUS**	**90**	**78**	**100**	**75**	**93**	**100**	**98**	**99**	**94**	**97**	**100**
ALL Ages	# SUS	1221	1082	1382	1045	1265	1344	1332	1345	1301	1311	1371
	# TESTED	1347	1380	1382	1380	1348	1344	1351	1348	1376	1348	1371
	% SUS	**88**	**77**	**100**	**75**	**93**	**100**	**99**	**99**	**95**	**97**	**100**
≥ 17 years	# SUS	846	764	984	737	897	955	952	955	934	933	975
	# TESTED	957	982	984	982	958	955	961	958	978	958	975
	% SUS	**96**	**79**	**100**	**77**	**94**	**100**	**97**	**100**	**92**	**96**	**100**
< 17 years	# SUS	375	318	398	308	368	389	380	390	367	378	396
	# TESTED	390	398	398	398	390	389	390	390	398	390	396
	% SUS	**90**	**77**	**100**	**77**	**93**	**100**	**97**	**100**	**99**	**98**	**100**
UAH 3C3/3C4	# SUS	81	69	90	69	84	90	87	89	89	87	90
	# TESTED	90	90	90	90	90	90	90	89	90	89	90
	% SUS	**90**	**84**	**100**	**84**	**100**	**100**	**100**	**100**	**96**	**96**	**100**
UAH 3C2	# SUS	29	27	32	27	32	32	32	32	31	31	32
	# TESTED	32	32	32	32	32	32	32	32	32	32	32
	% SUS	**94**	**83**	**100**	**77**	**100**	**100**	**100**	**100**	**93**	**98**	**100**
CCI	# SUS	55	51	64	48	60	60	61	60	59	59	61
	# TESTED	59	62	64	62	60	60	61	60	63	60	61

***Staphylococcus aureus* - MRSA**												
All Specimen Sources		**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**RIF**	**SXT**	**TET**	**VAN**
Community-associated	**% SUS**	**19**	**71**	**0**	**17**	**98**	**100**	**100**	**100**	**95**	**97**	**100**
	# SUS	20	77	0	18	106	108	108	108	103	105	108
	# TESTED	108	108	108	108	108	108	108	108	108	108	108
Hospital-associated	**% SUS**	**13**	**8**	**0**	**8**	**52**	**100**	**100**	**100**	**48**	**52**	**100**
	# SUS	8	5	0	5	31	60	60	60	29	31	60
	# TESTED	60	60	60	60	60	60	60	60	60	60	60

Resistance and isolation rates of *S. aureus* (ie. MSSA) remain relatively stable. However, the prevalence of methicillin-resistant *S.aureus* (MRSA) isolates, 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) which, 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-sulphamethoxazole 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 2008 was 4%, 7%, 18%, 25%, and 28%, respectively. In 2008, 529 (470 Adult, 59 Pediatric) MRSA isolates were identified with susceptibility testing but genotype data is available only for the subset displayed in the table; no linezolid resistance and only one isolate with intermediate vancomycin resistance (VISA) were detected. Similarly, 438 (414 Adult, 24 Pediatric) MRSA were identified in 2007 and all were susceptible to linezolid and vancomycin.

CA-MRSA resistance to clindamycin was 12% in 2007 (n=73) and increased to 29% in 2008 (n=100) while resistance to gentamicin and trimethoprim-sulphamethoxazole in 2007-08 remained less than 5%, similar to MSSA.

***Staphylococcus* species, coagulase-negative**											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
All Patients	**% SUS**	**38**	**48**	**43**	**37**	**32**	**70**	**99**	**10**	**54**	**100**
ALL Ages	# SUS	125	144	144	121	107	210	298	33	176	330
	# TESTED	328	301	335	328	334	300	301	333	326	330
≥ 17 years old	**% SUS**	**40**	**43**	**45**	**39**	**34**	**74**	**99**	**10**	**55**	**100**
	# SUS	106	105	122	104	92	180	242	27	146	266
	# TESTED	264	244	271	266	271	243	244	269	265	266
< 17 years old	**% SUS**	**28**	**66**	**34**	**30**	**25**	**52**	**98**	**10**	**49**	**100**
	# SUS	18	38	22	19	16	30	56	6	30	64
	# TESTED	64	57	64	62	63	57	57	64	61	64
UAH 3C3/3C4	**% SUS**	**23**	**38**	**37**	**23**	**19**	**68**	**100**	**11**	**48**	**100**
	# SUS	5	7	8	5	4	13	19	2	10	21
	# TESTED	22	19	22	22	22	19	19	22	21	21

Staphylococcus lugdunensis											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
ALL Ages	**% SUS**	**97**	**97**	**91**	**97**	**85**	**97**	**100**	**53**	**81**	**100**
	# SUS	47	46	45	48	42	46	47	26	40	49
	# TESTED	48	47	49	49	49	47	47	49	49	49
≥ 17 years	**% SUS**	**100**	**97**	**90**	**100**	**83**	**97**	**100**	**51**	**79**	**100**
	# SUS	42	40	39	43	36	40	41	22	34	43
	# TESTED	42	41	43	43	43	41	41	43	43	43

Viridans Group Streptococci				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**98**	**69**	**100**
	# SUS	102	72	104
	# TESTED	104	104	104
≥ 17 years	**% SUS**	**98**	**76**	**100**
	# SUS	76	59	78
	# TESTED	78	78	78
< 17 years	**% SUS**	**96**	**46**	**100**
	# SUS	25	12	26
	# TESTED	26	26	26

***Streptococcus anginosis* group**				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**99**	**99**	**100**
	# SUS	129	129	130
	# TESTED	130	130	130

Streptococcus pneumoniae		**CRO (M)**	**CRO (NM)**	**DOXY**	**ERY**	**LEV**	**MERO**	**PEN (M)**	**PEN (NM)**	**PEN (PO)**	**SXT**	**VAN**
All Specimen Sources												
All Patients	**% SUS**	**94**	**98**	**87**	**74**	**98**	**84**	**86**	**96**	**86**	**75**	**100**
ALL Ages	# SUS	114	118	129	124	179	39	177	197	177	126	194
	# TESTED	121	121	148	166	181	46	204	204	204	166	194
	% SUS	**95**	**97**	**86**	**74**	**98**	**84**	**86**	**96**	**86**	**74**	**100**
≥ 17 years old	# SUS	75	77	93	86	125	27	118	197	118	86	135
	# TESTED	79	79	108	115	127	32	137	204	137	115	135
	% SUS	**93**	**98**	**90**	**74**	**100**	**85**	**88**	**94**	**88**	**78**	**100**
< 17 years old	# SUS	39	41	36	38	54	12	59	63	59	40	59
	# TESTED	42	42	40	51	54	14	67	67	67	51	59
	% SUS	**93**	**96**	**87**	**76**	**100**	**95**	**87**	**98**	**87**	**65**	**100**
UAH 3C3/3C4	# SUS	25	26	29	26	37	14	32	36	32	22	37
	# TESTED	27	27	33	34	37	15	37	37	37	34	37

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 2008 was 14%, 4%, and 14%, respectively. Similarly, ceftriaxone rates for meningeal and non-meningeal infections were 6% and 2%, 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 increased from 14% in 2006, to 20% in 2007, to 26% in 2008. No vancomycin resistance has been detected to date in *S. pneumoniae*. Trimethoprim-sulphamethoxazole resistance has remained stable at ~25% for the last several years and quinolone resistance is rare.

Streptococcus pyogenes				
All Specimen Sources		**CLIN**	**ERY**	**PEN**
	% SUS	**87**	**87**	**100**
ALL Ages	# SUS	48	48	55
	# TESTED	55	55	55

***Candida* species**							
All Specimen Sources		**AMB**	**5-FC**	**ITRA**	**FLUC**	**VORI**	**CASP**
C. albicans	**% SUS**	**100**	**99**	**89**	**98**	**98**	**100**
ALL Ages	# SUS	95	94	85	93	93	95
	# TESTED	95	95	95	95	95	95
C. glabrata	**% SUS**	**100**	**100**	**3**	**69**	**94**	**100**
ALL Ages	# SUS	68	68	2	47	64	68
	# TESTED	68	68	68	68	68	68
C. parapsilosis	**% SUS**	**100**	**100**	**85**	**100**	**100**	**92**
ALL Ages	# SUS	13	13	11	13	13	12
	# TESTED	13	13	13	13	13	13
C. tropicalis	**% SUS**	**100**	**100**	**65**	**88**	**94**	**94**
ALL Ages	# SUS	17	17	11	15	16	16
	# TESTED	17	17	17	17	17	17

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 (30%), which is consistent with global resistance rates.

2007 Antibiogram Tables

***Acinetobacter baumanni* complex**								
All Specimen Sources		**CAZ**	**CIP**	**COL**	**GEN**	**IMI**	**TOB**	**SXT**
ALL Ages	**% SUS**	**86**	**98**	**100**	**91**	**98**	**80**	**91**
	# SUS	38	43	35	40	43	35	40
	# TESTED	44	44	35	44	44	44	44
≥ 17 years	**% SUS**	**83**	**97**	**100**	**91**	**97**	**97**	**89**
	# SUS	29	34	28	32	34	34	31
	# TESTED	35	35	28	35	35	35	35

***Burkholderia cepacia* complex**								
All Specimen Sources		**CAZ**	**CIP**	**GEN**	**IMI**	**MERO**	**PIP**	**SXT**
CF Patients	**% SUS**	**48**	**16**	**3**	**23**	**55**	**52**	**48**
ALL Ages	# SUS	15	5	1	7	17	16	15
	# TESTED	31	31	31	31	31	31	31
≥ 17 years	**% SUS**	**68**	**23**	**5**	**9**	**64**	**68**	**55**
	# SUS	15	5	1	2	14	15	12
	# TESTED	22	22	22	22	22	22	22
< 17 years	**% SUS**	**0**	**0**	**0**	**56**	**33**	**11**	**33**
	# SUS	0	0	0	5	3	1	3
	# TESTED	9	9	9	9	9	9	9

***Citrobacter freundii* complex**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**78**	**0**	**89**	**91**	**100**	**96**	**82**
	# SUS	0	0	100	0	115	117	129	124	106
	# TESTED	129	129	129	129	129	129	129	129	129
≥ 17 years	**% SUS**	**0**	**0**	**79**	**0**	**88**	**89**	**100**	**97**	**84**
	# SUS	0	0	82	0	91	93	104	101	87
	# TESTED	104	104	104	104	104	104	104	104	104
< 17 years	**% SUS**	**0**	**0**	**72**	**0**	**96**	**96**	**100**	**92**	**76**
	# SUS	0	0	18	0	24	24	25	23	19
	# TESTED	25	25	25	25	25	25	25	25	25

Citrobacter koseri										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**81**	**100**	**81**	**100**	**100**	**100**	**54**	**96**
	# SUS	0	21	26	21	26	26	26	14	25
	# TESTED	26	26	26	26	26	26	26	26	26
≥ 17 years	**% SUS**	0	80	100	80	100	100	100	52	96
	# SUS	0	20	25	20	25	25	25	13	24
	# TESTED	25	25	25	25	25	25	25	25	25

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

Enterobacter aerogenes										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**88**	**0**	**99**	**100**	**100**	**25**	**96**
ALL Ages	# SUS	0	0	59	0	66	67	67	17	64
	# TESTED	67	67	67	47	67	67	67	67	67
	% SUS	0	0	89	0	98	100	100	26	95
≥ 17 years	# SUS	0	0	55	0	61	62	62	16	59
	# TESTED	62	62	62	43	62	62	62	62	62

Enterobacter cloacae										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**0**	**75**	**0**	**90**	**95**	**99**	**33**	**88**
ALL Ages	# SUS	0	0	247	0	297	315	326	108	292
	# TESTED	330	330	330	178	330	330	330	330	330
	% SUS	**0**	**0**	**75**	**0**	**88**	**95**	**99**	**31**	**88**
≥ 17 years	# SUS	0	0	206	0	240	258	269	84	240
	# TESTED	273	273	273	151	273	273	273	273	273
	% SUS	**0**	**0**	**72**	**0**	**100**	**100**	**100**	**42**	**91**
< 17 years	# SUS	0	0	41	0	57	57	57	24	52
	# TESTED	57	57	57	27	57	57	57	57	57
	% SUS	**0**	**0**	**66**	**0**	**79**	**90**	**100**	**38**	**79**
UAH 3C3/3C4	# SUS	0	0	19	0	23	26	29	11	23
	# TESTED	29	29	29	18	29	29	29	29	29

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

Escherichia coli										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**54**	**86**	**95**	**86**	**77**	**90**	**100**	**98**	**71**
ALL Ages	# SUS	1256	1983	2200	1199	1777	2082	2314	2269	1653
	# TESTED	2314	2314	2308	1390	2314	2314	2314	2313	2314
	% SUS	**54**	**84**	**95**	**85**	**72**	**89**	**100**	**98**	**71**
≥ 17 years	# SUS	969	1519	1699	921	1293	1599	1798	1762	1272
	# TESTED	1798	1798	1793	1084	1798	1798	1798	1797	1798
	% SUS	**56**	**90**	**97**	**91**	**94**	**94**	**100**	**98**	**74**
< 17 years	# SUS	287	463	500	277	483	482	515	506	381
	# TESTED	515	515	514	305	515	515	515	515	515
	% SUS	**45**	**79**	**94**	**87**	**72**	**95**	**100**	**97**	**67**
UAH 3C3/3C4	# SUS	35	62	73	45	56	74	78	75	52
	# TESTED	78	78	78	52	78	78	78	77	78
	% SUS	**59**	**90**	**95**	**89**	**81**	**93**	**100**	**100**	**78**
CCI	# SUS	59	90	95	57	81	93	100	100	78
	# TESTED	100	100	100	64	100	100	100	100	100

***Escherichia coli* - ESBL Producers**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**0**	**28**	**78**	**100**	**93**	**43**
ALL Ages	# SUS	0	0	0	0	33	94	120	112	51
	# TESTED	120	120	120	120	120	120	120	120	120
	% SUS	**0**	**0**	**0**	**0**	**21**	**67**	**100**	**95**	**43**
≥ 17 years	# SUS	0	0	0	0	21	68	101	96	43
	# TESTED	101	101	101	101	101	101	101	101	101

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. ESBL-positive *E. coli* isolation rates have increased significantly in the last several years; <1% in 2005, 2.5% in 2006, 5.2% in 2007, and 3.6% in 2008. A significant number of ESBL *E. coli* are also resistant to other antibiotic classes including quinolones (83%), aminoglycosides (43%), and trimethoprim-sulfamethoxazole (68%); 2008 data.

Haemophilus influenzae					
All Specimen Sources		**AMP**	**CRO**	**CXM**	**SXT**
ALL Ages	**% SUS**	**85**	**100**	**98**	**84**
	# SUS	203	61	51	38
	# TESTED	238	61	52	45
≥ 17 years	**% SUS**	**86**	**100**	**97**	**83**
	# SUS	140	40	32	25
	# TESTED	162	40	33	30
< 17 years	**% SUS**	**83**	**100**	**100**	**87**
	# SUS	62	21	19	13
	# TESTED	75	21	19	15

***Klebsiella* species**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**80**	**98**	**89**	**94**	**96**	**100**	**57**	**90**
ALL Ages	# SUS	0	627	769	675	741	757	788	449	708
	# TESTED	788	788	788	762	788	788	788	788	788
	% SUS	**0**	**82**	**99**	**89**	**94**	**98**	**100**	**52**	**91**
≥ 17 years	# SUS	0	508	614	534	582	608	622	326	567
	# TESTED	622	622	622	600	622	622	622	622	622
	% SUS	**0**	**72**	**93**	**87**	**96**	**90**	**100**	**74**	**85**
< 17 years	# SUS	0	119	155	141	159	149	166	123	141
	# TESTED	166	166	166	162	166	166	166	166	166
	% SUS	**0**	**81**	**98**	**80**	**81**	**91**	**100**	**51**	**85**
UAH 3C3/3C4	# SUS	0	43	52	40	43	48	53	27	45
	# TESTED	53	53	53	50	53	53	53	53	53
	% SUS	**0**	**87**	**100**	**98**	**100**	**100**	**100**	**66**	**96**
CCI	# SUS	0	41	47	44	47	47	47	31	45
	# TESTED	47	47	47	45	47	47	47	47	47

***Klebsiella* species - ESBL Producers**										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
	% SUS	**0**	**0**	**0**	**0**	**63**	**63**	**100**	**59**	**63**
ALL Ages	# SUS	0	0	0	0	17	17	27	16	17
	# TESTED	27	27	27	27	27	27	27	27	27
	% SUS	**0**	**0**	**0**	**0**	**64**	**100**	**100**	**43**	**100**
≥ 17 years	# SUS	0	0	0	0	9	14	14	6	14
	# TESTED	14	14	14	14	14	14	14	14	14

The extended-spectrum β-lactamase (ESBL) resistance phenotype confers resistance to all third-generation cephalosporins and, in many cases, piperacillin-tazobactam. *Klebsiella* ESBL prevalence seems to be on the rise with isolation rates of 2.3%, 3.4%, and 4.2% in 2006, 2007, and 2008, respectively. Cross-resistance rates in 2008 to the quinolones, aminoglycosides, and trimethoprim-sulfamethoxazole were 31%, 28%, and 37%, respectively.

Morganella morganii										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**0**	**0**	**91**	**0**	**93**	**87**	**100**	**0**	**83**
	# SUS	0	0	49	0	50	47	54	0	45
	# TESTED	54	54	54	54	54	54	54	54	54
≥ 17 years	**% SUS**	**0**	**0**	**94**	**0**	**91**	**87**	**100**	**0**	**83**
	# SUS	0	0	44	0	43	41	47	0	39
	# TESTED	47	47	47	47	47	47	47	47	47

Proteus mirabilis										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
ALL Ages	**% SUS**	**71**	**89**	**99**	**98**	**84**	**96**	**100**	**0**	**77**
	# SUS	111	139	154	140	131	150	125	0	120
	# TESTED	156	156	156	143	156	156	125	156	156
≥ 17 years	**% SUS**	**72**	**91**	**99**	**99**	**81**	**95**	**100**	**0**	**77**
	# SUS	92	117	127	117	104	122	105	0	99
	# TESTED	128	128	128	118	128	128	105	128	128
< 17 years	**% SUS**	**68**	**79**	**96**	**92**	**96**	**100**	**100**	**0**	**75**
	# SUS	19	22	27	23	27	28	20	0	21
	# TESTED	28	28	28	25	28	28	20	28	28

Pseudomonas aeruginosa									
All Specimen Sources		**AMK**	**CAZ**	**CIP**	**GEN**	**IMI**	**MERO**	**PIP**	**TOB**
All Patients	**% SUS**	**79**	**89**	**76**	**74**	**82**	**89**	**88**	**89**
	# SUS	881	997	849	831	919	966	818	1003
ALL Ages	# TESTED	1119	1124	1123	1124	1116	1082	932	1124
	% SUS	**79**	**88**	**71**	**75**	**80**	**89**	**88**	**89**
≥ 17 years	# SUS	690	775	617	658	697	742	640	783
	# TESTED	871	876	875	876	869	838	726	876
	% SUS	**77**	**90**	**94**	**70**	**90**	**92**	**86**	**89**
< 17 years	# SUS	191	222	232	173	222	224	178	220
	# TESTED	248	248	248	248	247	244	206	248
Non-CF Patients	**% SUS**	**96**	**90**	**72**	**87**	**83**	**91**	**92**	**96**
	# SUS	653	615	491	594	562	583	457	658
ALL Ages	# TESTED	683	686	685	686	678	644	497	686
	% SUS	**96**	**90**	**69**	**88**	**82**	**90**	**92**	**96**
≥17 years	# SUS	554	518	396	508	466	486	394	555
	# TESTED	575	578	577	578	571	540	429	578
	% SUS	**92**	**90**	**88**	**80**	**90**	**93**	**93**	**95**
< 17 years	# SUS	99	97	95	86	96	97	63	103
	# TESTED	108	108	108	108	107	104	68	108
CF Patients	**% SUS**	**52**	**87**	**82**	**54**	**82**	**87**	**83**	**79**
	# SUS	228	382	358	237	357	383	361	345
ALL Ages	# TESTED	436	438	438	438	438	438	435	438
	% SUS	**46**	**86**	**74**	**50**	**78**	**86**	**83**	**77**
≥ 17 years	# SUS	136	257	221	150	231	256	246	228
	# TESTED	296	298	298	298	298	298	297	298
	% SUS	**66**	**89**	**98**	**62**	**90**	**91**	**83**	**84**
< 17 years	# SUS	92	125	137	87	126	127	115	117
	# TESTED	140	140	140	140	140	140	138	140
	% SUS	**92**	**86**	**71**	**88**	**80**	**89**	**90**	**96**
UAH 3C3/3C4	# SUS	47	44	36	45	40	41	37	49
	# TESTED	51	51	51	51	50	46	41	51

Resistance rates in *P. aeruginosa* have remained relatively unchanged for over four years of surveillance in patients with and without cystic fibrosis and in both adult and paediatric populations.

Serratia marcescens										
All Specimen Sources		**AMP**	**FAZ**	**CRO**	**CXM**	**CIP**	**GEN**	**IMI**	**NIT**	**SXT**
All Patients	**% SUS**	**0**	**0**	**84**	**0**	**86**	**99**	**98**	**0**	**98**
ALL Ages	# SUS	0	0	103	0	104	121	120	0	120
	# TESTED	122	122	122	122	121	122	122	122	122
	% SUS	**0**	**0**	**81**	**0**	**84**	**100**	**99**	**0**	**98**
≥ 17 years	# SUS	0	0	81	0	83	100	99	0	98
	# TESTED	100	100	100	100	99	100	100	100	100
	% SUS	**0**	**0**	**100**	**0**	**95**	**95**	**95**	**0**	**100**
< 17 years	# SUS	0	0	22	0	21	21	21	0	22
	# TESTED	22	22	22	22	22	22	22	22	22

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

Stenotrophomonas maltophilia				
All Specimen Sources		**DOXY**	**TIM**	**SXT**
All Patients	**% SUS**	**65**	**31**	**97**
ALL Ages	# SUS	199	94	294
	# TESTED	304	304	304
	% SUS	**60**	**32**	**96**
≥ 17 years	# SUS	127	68	204
	# TESTED	213	213	213
	% SUS	**79**	**29**	**99**
< 17 years	# SUS	72	26	90
	# TESTED	91	91	91
	% SUS	**69**	**28**	**97**
UAH 3C3/3C4	# SUS	27	11	38
	# TESTED	39	39	39

***Enterococcus* species**							
All Specimen Sources		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT**	**VAN**
All Patients	**% SUS**	**85**	**31**	**69**	**68**	**80**	**99**
ALL Ages	# SUS	1307	475	1058	1040	1229	1524
	# TESTED	1538	1536	1538	1524	1537	1538
	% SUS	**83**	**25**	**64**	**70**	**78**	**99**
≥ 17 years	# SUS	1045	320	799	874	980	1247
	# TESTED	1258	1256	1258	1246	1257	1258
	% SUS	**94**	**55**	**93**	**60**	**89**	**99**
< 17 years	# SUS	262	155	259	166	249	277
	# TESTED	280	280	280	278	280	280
	% SUS	**62**	**17**	**68**	**81**	**56**	**100**
UAH 3C3/3C4	# SUS	52	14	57	68	47	84
	# TESTED	84	84	84	84	84	84
	% SUS	**88**	**28**	**72**	**68**	**83**	**100**
CCI	# SUS	61	19	50	46	57	69
	# TESTED	69	69	69	68	69	69

Enterococcus faecalis							
Blood Specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT***	**VAN**
	% SUS	**100**	**42**	**58**	**78**	**94**	**100**
ALL Ages	# SUS	36	15	21	28	34	36
	# TESTED	36	36	36	36	36	36

Enterococcus faecium							
Blood Specimens		**AMP**	**CIP**	**GM500**	**LNZ**	**NIT***	**VAN**
	% SUS	**16**	**6**	**88**	**94**	**0**	**97**
ALL Ages	# SUS	5	2	28	30	0	31
	# TESTED	32	32	32	32	32	32

*, for urninary tract infections only

Resistance rates in enterococci have not changed significantly over the last four years. However, the potential for resistance to vancomycin (VRE) is now a much greater concern. Enterococcal species identification is only performed for sterile site isolates but vancomycin resistance is confirmed for all clinically relevant isolates, regardless of specimen site. In 2008, resistance to vancomycin was 2%, which included 3 VRE bacteremic episodes and 29 non-sterile site isolates, primarily urine specimens. Similar findings were observed in 2007.

***Staphylococcus aureus* – MSSA**												
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**PEN**	**SXT**	**VAN**
All Patients	**% SUS**	**100**	**90**	**78**	**100**	**76**	**95**	**100**	**100**	**17**	**96**	**100**
ALL Ages	# SUS	1296	929	1031	1316	996	1241	1300	1304	227	1247	1302
	# TESTED	1299	1034	1318	1318	1318	1303	1300	1305	1305	1305	1306
	% SUS	**100**	**88**	**78**	**100**	**75**	**95**	**100**	**100**	**19**	**96**	**100**
≥ 17 years	# SUS	1002	700	798	1017	769	956	1014	1007	196	969	1007
	# TESTED	1005	797	1019	1019	1019	1007	1014	1008	1011	1008	1009
	% SUS	**100**	**97**	**78**	**100**	**76**	**96**	**100**	**100**	**11**	**94**	**99**
< 17 years	# SUS	293	228	232	298	226	284	294	296	31	277	294
	# TESTED	293	236	298	298	298	295	294	296	293	296	296
	% SUS	**98**	**84**	**71**	**98**	**68**	**95**	**100**	**100**	**19**	**98**	**99**
UAH 3C3/3C4	# SUS	98	58	71	98	68	94	99	99	19	98	99
	# TESTED	100	69	100	100	100	99	99	99	100	100	100
	% SUS	**98**	**90**	**80**	**100**	**78**	**100**	**100**	**100**	**10**	**100**	**100**
UAH 3C2	# SUS	39	28	33	41	32	40	40	40	4	41	40
	# TESTED	40	31	41	41	41	40	40	40	41	41	40
	% SUS	**100**	**97**	**86**	**100**	**85**	**98**	**100**	**100**	**15**	**91**	**100**
CCI	# SUS	64	56	56	65	55	63	63	64	10	59	64
	# TESTED	64	58	65	65	65	64	63	64	65	65	64

***Staphylococcus aureus* - MRSA**												
All Specimen Sources		**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**LNZ**	**NIT**	**RIF**	**TET**	**SXT**	**VAN**
Community-associated	**% SUS**	**7**	**88**	**0**	**3**	**96**	**100**	**100**	**100**	**95**	**100**	**100**
	# SUS	4	64	0	2	69	72	72	73	69	73	73
	# TESTED	55	73	73	73	72	72	72	73	73	73	73
Hospital-associated	**% SUS**	**0**	**0**	**0**	**0**	**34**	**100**	**100**	**100**	**32**	**34**	**100**
	# SUS	0	0	0	0	26	77	77	77	25	26	77
	# TESTED	60	77	77	77	77	77	77	77	77	77	77

Resistance and isolation rates of *S. aureus* (ie. MSSA) remain relatively stable. However, the prevalence of methicillin-resistant *S.aureus* (MRSA) isolates, 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) which, 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-sulphamethoxazole 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 2008 was 4%, 7%, 18%, 25%, and 28%, respectively. In 2008, 529 (470 Adult, 59 Pediatric) MRSA isolates were identified with susceptibility testing but genotype data is available only for the subset displayed in the table; no linezolid resistance and only one isolate with intermediate vancomycin resistance (VISA) were detected. Similarly, 438 (414 Adult, 24 Pediatric) MRSA were identified in 2007 and all were susceptible to linezolid and vancomycin.

CA-MRSA resistance to clindamycin was 12% in 2007 (n=73) and increased to 29% in 2008 (n=100) while resistance to gentamicin and trimethoprim-sulphamethoxazole in 2007-08 remained less than 5%, similar to MSSA.

***Staphylococcus* species, coagulase-negative**											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
All Patients	**% SUS**	**39**	**49**	**51**	**39**	**32**	**69**	**99**	**10**	**49**	**100**
ALL Ages	# SUS	120	139	164	126	101	194	281	32	148	315
	# TESTED	307	282	320	320	320	282	284	318	304	315
	% SUS	**38**	**45**	**50**	**38**	**30**	**68**	**99**	**10**	**45**	**100**
≥ 17 years old	# SUS	97	105	134	101	80	160	234	27	116	263
	# TESTED	257	235	268	265	267	234	236	266	256	263
	% SUS	**46**	**72**	**58**	**52**	**40**	**71**	**98**	**10**	**62**	**100**
< 17 years old	# SUS	23	34	30	27	21	34	47	5	32	52
	# TESTED	50	47	52	52	52	48	48	52	52	52
	% SUS	**22**	**30**	**32**	**20**	**20**	**55**	**100**	**12**	**35**	**100**
UAH 3C3/3C4	# SUS	5	6	8	5	5	11	20	3	8	25
	# TESTED	23	20	25	25	25	20	20	25	23	25

Staphylococcus lugdunensis											
All Specimen Sources		**FAZ**	**CIP**	**CLIN**	**CLOX**	**ERY**	**GEN**	**NIT**	**PEN**	**SXT**	**VAN**
	% SUS	**100**	**90**	**73**	**100**	**77**	**97**	**100**	**67**	**73**	**100**
ALL Ages	# SUS	30	26	22	30	23	28	29	20	22	30
	# TESTED	30	29	30	30	30	29	29	30	30	30
	% SUS	**100**	**89**	**75**	**100**	**79**	**96**	**100**	**64**	**71**	**100**
≥ 17 years	# SUS	28	24	21	28	22	27	27	18	20	28
	# TESTED	28	27	28	28	28	28	27	28	28	28

Viridans Group Streptococci				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**100**	**82**	**100**
	# SUS	104	85	104
	# TESTED	104	104	104
≥ 17 years	**% SUS**	**100**	**86**	**100**
	# SUS	83	71	83
	# TESTED	83	83	83
< 17 years	**% SUS**	**100**	**67**	**100**
	# SUS	21	14	21
	# TESTED	21	21	21

***Streptococcus anginosis* group**				
All Specimen Sources		**CRO**	**PEN**	**VAN**
ALL Ages	**% SUS**	**100**	**97**	**100**
	# SUS	95	92	95
	# TESTED	95	95	95

Streptococcus pneumoniae								
All Specimen Sources		**CRO**	**ERY**	**LEV**	**MERO**	**PEN**	**SXT**	**VAN**
All Patients ALL Ages	**% SUS**	**100**	**80**	**100**	**96**	**91**	**75**	**100**
	# SUS	207	185	244	165	223	172	237
	# TESTED	208	231	244	171	245	230	237
≥ 17 years old	**% SUS**	**99**	**81**	**100**	**99**	**95**	**77**	**100**
	# SUS	144	135	177	118	168	127	172
	# TESTED	145	166	177	119	177	166	172
< 17 years old	**% SUS**	**100**	**77**	**100**	**90**	**81**	**70**	**100**
	# SUS	63	49	66	47	54	44	65
	# TESTED	63	64	66	52	67	63	65
UAH 3C3/3C4	**% SUS**	**100**	**83**	**100**	**100**	**94**	**78**	**100**
	# SUS	28	30	36	22	34	28	35
	# TESTED	28	36	36	22	36	36	35

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 2008 was 14%, 4%, and 14%, respectively. Similarly, ceftriaxone rates for meningeal and non-meningeal infections were 6% and 2%, 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 increased from 14% in 2006, to 20% in 2007, to 26% in 2008. No vancomycin resistance has been detected to date in *S. pneumoniae*. Trimethoprim-sulphamethoxazole 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**	**71**	**70**	**100**
	# SUS	45	44	59
	# TESTED	63	63	59

***Candida* species**							
All Specimen Sources		**AMB**	**5-FC**	**ITRA**	**FLUC**	**VORI**	**CASP**
C. albicans	**% SUS**	**98**	**94**	**90**	**99**	**100**	**95**
ALL Ages	# SUS	84	81	77	85	86	82
	# TESTED	86	86	86	86	86	86
C. glabrata	**% SUS**	**93**	**100**	**4**	**67**	**86**	**100**
ALL Ages	# SUS	53	57	2	38	49	57
	# TESTED	57	57	57	57	57	57
C. parapsilosis	**% SUS**	**80**	**100**	**87**	**100**	**100**	**100**
ALL Ages	# SUS	12	15	13	15	15	15
	# TESTED	15	15	15	15	15	15
C. tropicalis	**% SUS**	**77**	**100**	**54**	**100**	**100**	**92**
ALL Ages	# SUS	10	13	7	13	13	12
	# TESTED	13	13	13	13	13	13

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 (30%), which is consistent with global resistance rates.