

# 2018 Minnesota Statewide Acute Care Antibigram

## Background

Antibiotic resistance is one of our greatest clinical and public health challenges. According to the Centers for Disease Control and Prevention, more than 2.8 million antibiotic-resistant infections occur in the United States each year, and at least 35,000 people die as a result.<sup>1</sup> Minnesota Department of Health (MDH) conducts surveillance for antibiotic-resistant organisms of public health concern and reports on these organisms annually.<sup>2</sup> Clinical antibiograms summarize the antibiotic susceptibility profiles of a wider range of bacteria isolated from patients in individual health care facilities. Most hospitals and health systems generate these antibiograms annually. The Minnesota One Health Antibiotic Stewardship Collaborative (MOHASC) has worked with MDH to develop an annual statewide antibiogram initiative, compiling susceptibility data from hospitals across Minnesota.

Annual statewide antibiograms will provide MDH with a tool to track trends in the percent of clinical bacterial isolates susceptible to selected antibiotic drugs. The 2018 Minnesota Statewide Acute Care Antibigram is the first of these, with 21 hospitals included. We anticipate that hospital participation will increase once awareness of this voluntary initiative grows, which will allow a more comprehensive understanding of susceptibility patterns statewide and in the eight regions of Minnesota's Health Care Coalitions.

MDH and its partners in MOHASC and the Minnesota Collaborative Healthcare-Associated Infections Network work with leaders in hospitals and health systems to reduce infections caused by resistant organisms and change antibiotic prescribing behaviors. The annual Minnesota Statewide Acute Care Antibigram provides a new tool for use in our efforts to slow the development of antibiotic resistance.

## Methodology

Twenty-one of 134 (16%) acute care Minnesota hospitals voluntarily submitted 2018 inpatient antibiograms. Antibiograms were submitted in a variety of formats, including PDF, Microsoft Word, and Microsoft Excel. Data were compiled for a set of organism-antibiotic drug combinations of interest to MDH and MOHASC partners. Not every hospital antibiogram included susceptibility results for all organism-antibiotic drug combinations. When necessary, results at the species level were compiled into a genus group (e.g., *Citrobacter* organisms grouped as a single "*Citrobacter* spp." category). The number of isolates tested and percent susceptible were used to compute a weighted average of percent susceptible across institutions. This was done by 1) determining the number of susceptible isolates at each institution for each bug-drug combination (number of isolates x percent susceptible); 2) summing the number of susceptible isolates across all institutions for each bug-drug combination; 3) summing the total number of isolates across all institutions for each bug-drug combination; and 4) dividing the summed number of susceptible isolates by the total number of isolates to get an overall percent susceptible for each bug-drug combination. The range of percent susceptible across hospitals was determined for each organism-antibiotic drug combination. Hospitals that reported percent susceptible for fewer than 30 isolates were included in generation of the weighted average of percent susceptible, facility number, and number of isolates, but were excluded from the percent susceptible range. The number of hospitals contributing to each weighted percent and percent range is noted in the tables.

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<sup>1</sup> CDC. Antibiotic Resistance Threats in the United States, 2019. Atlanta, GA: U.S. Department of Health and Human Services, CDC; 2019. Available at <https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf>.

<sup>2</sup> Minnesota Department of Health. Annual Summary of Disease Activity: Disease Control Newsletter. Available at: <https://health.mn.gov/diseases/reportable/dcn/index.html>.

## Limitations

This 2018 statewide antibiogram has several limitations:

- Data reflect isolates from only 21 (16%) Minnesota hospitals.
- One antibiogram submitted included results from several small hospitals. The individual hospitals were counted in the overall number of submitters (n=21) but could not be reflected in the number of facilities contributing data for individual organism-antibiotic combinations. In future years, additional efforts will be made to ensure individual facility antibiograms are submitted whenever possible.
- Not all contributing hospitals followed Clinical and Laboratory Standards Institute (CLSI) M39 recommendations for generating their facility antibiogram. Some hospitals reported not using only the first isolate of a given species per patient per period, not including results hidden in cascaded reporting, including less than 30 isolates for each species, and/or not consistently excluding “intermediate” interpretation from their classification of susceptible.
- Not all submitted antibiograms reflect the full January–December 2018 time frame, because some hospitals experienced changes to electronic medical record systems during the 2018 calendar year.
- Laboratories utilize multiple susceptibility breakpoints (e.g., CLSI M100, FDA). Not all laboratories using CLSI breakpoints were using the most current version at the time of laboratory testing.

**Because of these limitations and geographic variation that cannot be accounted for in this 2018 Minnesota Statewide Acute Care Antibiogram, information in this document should not be used to inform clinical treatment decisions.** This report and data included in subsequent years’ statewide antibiograms will be used to understand changes in the susceptibility patterns of clinically important bacterial organisms over time.

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Minnesota One Health Antibiotic  
 Stewardship Collaborative

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## Gram-Negative

*Acinetobacter* spp., *Pseudomonas aeruginosa*, and *Stenotrophomonas maltophilia*

		Amikacin	Ampicillin/sulbactam	Aztreonam	Cefepime	Ceftazidime	Ceftriaxone	Ciprofloxacin	Gentamicin	Imipenem	Levofloxacin	Meropenem	Piperacillin-Tazobactam	Trimethoprim-Sulfamethoxazole	Tobramycin
<i>Acinetobacter</i> spp.	%S	97	97	R	87	93	67	88	90		90	96	90	88	93
	Total Isolates	115	134		145	145	85	145	145		145	140	119	122	142
	Total Facilities	2	3		4	4	2	4	4		4	4	3	3	4
	Range % S*	91-99	94-97		82-91	94-97	-	88-93	85-88		91-94	94-99	88-92	88-88	88-92
	# Facilities Included in Range	2	2		2	2	1	2	2		2	2	2	2	2
<i>P. aeruginosa</i>	%S	77	R	60	87	82	R	71	75	60	68	79	81	R	87
	Total Isolates	4158		1930	5537	5561		5404	5557	2030	5559	4834	5488		5497
	Total Facilities	8		2	13	14		12	14	4	14	11	14		14
	Range % S*	42-100		54-78	43-97	62-97		36-93	29-98	47-95	38-90	57-97	62-100		58-100
	# Facilities Included in Range	7		2	13	13		12	14	4	13	10	13		13
<i>S. maltophilia</i>	%S		R	R		28	R		R	R	75	R	R	94	R
	Total Isolates					645					712			713	
	Total Facilities					5					7			7	
	Range % S*					23-50					68-92			93-100	
	# Facilities Included in Range					4					5			5	

R = intrinsic resistance

\* Range only reported when more than one facility and ≥30 isolates per facility

2018 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

*E. coli*

		Amikacin	Amoxicillin/Clavulante	Ampicillin	Ampicillin/Sulbactam	Aztreonam	Cefazolin	Cefepime	Cefotaxime	Cefoxitin	Ceftazidime	Ceftriaxone	Cefuroxime	Ciprofloxacin	Ertapenem	Fosfomycin	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin-Tazobactam	Tetracycline	Trimethoprim-Sulfamethoxazole	Tobramycin
<i>E. coli</i>	%S	100	87	58	64	93	90	98	97	93	97	97	97	84	100		94	100	83	100		97	83	79	95
	Total Isolates	18688	30	27185	25805	5189	20807	28313	30	14134	27332	28314	30	26863	5643		28466	5188	28459	21447		28460	30	28461	27510
	Total Facilities	9	1	14	13	4	11	14	1	6	13	14	1	13	5		15	4	15	12		15	1	15	15
	Range % S*	100-100	-	39-77	41-77	91-94	73-96	92-100	-	92-97	91-100	89-100	-	78-100	100-100		86-97	100-100	77-89	100-100		86-98	-	60-84	89-97
	# Facilities Included in Range	9	1	14	13	4	11	14	1	6	13	14	1	13	5		15	4	15	12		15	1	15	15
<i>E. coli (urine only)</i>	%S	100		55	66	92	90	94			92	90		80	100	98	92		81	100	97	99		78	92
	Total Isolates	1010		1010	1010	1010	7178	1010			1010	1010		1010	1010	1010	1010		1010	1010	4573	1010		1010	1010
	Total Facilities	1		1	1	1	5	1			1	1		1	1	1	1		1	1	5	1		1	1
	Range % S*	-		-	-	-	74-94	-			-	-		-	-	-	-		-	-	96-99	-		-	-
	# Facilities Included in Range	1		1	1	1	5	1			1	1		1	1	1	1		1	1	5	1		1	1

\* Range only reported when more than one facility and ≥30 isolates per facility

2018 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

*Klebsiella* spp.

		Amikacin	Ampicillin	Ampicillin/ Sulbactam	Aztreonam	Cefazolin	Cefepime	Cefoxitin	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin- Tazobactam	Trimethoprim- Sulfamethoxazole	Tobramycin
<i>K. aerogenes</i>	%S	100	R	R	87	R	100	R	82	81	99	100	99		99	100	13	83	99	99
	Total Isolates	274			125		357		346	344	304	128	357		357	327	306	344	357	351
	Total Facilities	6			2		7		7	7	6	3	7		7	7	7	7	7	7
	Range % S*	100-100			81-94		99-100		75-92	75-90	97-100	100-100	97-100		97-100	100-100	9-21	79-90	96-100	97-100
	# Facilities Included in Range	5			2		6		6	6	5	2	6		6	6	6	6	6	6
<i>K. oxytoca</i>	%S	100	R	62	96	54	99	98	99	98	99	100	99	100	99	100	86	96	83	98
	Total Isolates	725		1151	167	867	1208	384	1161	1208	1111	193	1208	258	1205	892	754	1159	1206	1177
	Total Facilities	6		11	3	8	12	5	11	12	10	4	12	3	12	9	10	11	12	12
	Range % S*	99-100		40-75	91-100	46-74	94-100	97-100	94-100	89-100	96-100	100-100	95-100	100-100	95-100	100-100	81-94	89-99	91-99	95-100
	# Facilities Included in Range	5		11	3	7	11	4	10	11	9	3	11	3	11	8	8	10	11	11
<i>K. pneumoniae</i>	%S	100	R	87	92	95	98	96	97	97	97	99	98	100	97	100	33	96	91	98
	Total Isolates	3334		4941	1129	4762	5129	2319	4959	5130	4698	1220	5163	841	5161	4060	4044	5162	5163	5033
	Total Facilities	8		13	4	13	13	5	12	13	11	5	14	3	14	11	13	14	14	14
	Range % S*	100-100		77-92	90-95	82-98	91-100	95-97	91-100	89-100	92-99	99-100	94-100	100-100	94-99	99-100	0-76	94-100	50-96	94-100
	# Facilities Included in Range	7		12	4	12	13	5	12	13	11	5	13	3	13	10	12	13	13	13
<i>Klebsiella</i> spp. **	%S	100	R	75	92	33	97		98	91	94	100	94	99	99	100	78	93	96	93
	Total Isolates	156		303	156	156	303		303	303	303	156	303	147	303	156	241	303	303	303
	Total Facilities	1		4	1	1	4		4	4	4	1	4	3	4	1	3	4	4	4
	Range % S*	-		57-98	-	-	95-98		97-100	83-98	80-98	-	77-100	98-100	97-100	-	78-80	87-100	95-97	77-98
	# Facilities Included in Range	1		3	1	1	3		3	3	3	1	3	2	3	1	2	3	3	3

R = intrinsic resistance

\* Range only reported when more than one facility and ≥30 isolates per facility

\*\* May include isolates from *K. aerogenes*, *K. oxytoca*, and/or *K. pneumoniae*

2018 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

Other Gram-Negative Species

		Amikacin	Ampicillin	Ampicillin/ Sulbactam	Aztreonam	Cefazolin	Cefepime	Cefoxitin	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin- Tazobactam	Trimethoprim- Sulfamethoxazole	Tobramycin
<i>Citrobacter</i> spp.	%S	100	R		86	23	99		84	84	93	98	95	97	93	100	94	87	87	96
	Total Isolates	679			242	31	1082		1026	1060	1002	273	1082	242	1080	797	896	1027	1082	1056
	Total Facilities	6			4	1	12		11	12	10	5	12	3	12	9	10	11	12	13
	Range % S*	98-100			81-100	-	96-100		79-93	79-90	88-100	96-100	89-100	94-98	87-100	98-100	84-100	82-93	79-97	91-100
	# Facilities Included in Range	6			3	1	11		10	11	10	4	11	3	11	8	9	10	11	11
<i>Enterobacter</i> spp.	%S	100	R	R	82	R	96	R	82	78	97	95	98	89	97	99	38	81	93	97
	Total Isolates	1274			513		2048		2000	2050	1870	545	2050	460	2050	1552	1333	2042	2050	2050
	Total Facilities	7			4		13		12	13	11	5	13	3	13	10	10	13	13	13
	Range % S*	99-100			70-86		92-100		72-90	68-88	95-100	92-100	93-100	89-90	95-100	94-100	31-66	0-90	88-100	90-100
	# Facilities Included in Range	7			4		13		12	13	11	5	13	3	13	10	9	13	13	13
<i>M. morganii</i>	%S	100	R	16	96	R	98	40	89	89	85	100	88		86	100	R	98	80	98
	Total Isolates	145		89	93		194	53	184	183	157	93	194		194	182		182	194	182
	Total Facilities	2		1	2		3	1	3	3	2	2	3		3	3		3	3	3
	Range % S*	100-100		-	89-100		91-100	-	84-90	88-89	80-88	100-100	83-91		81-90	100-100		94-100	72-84	96-98
	# Facilities Included in Range	2		1	2		3	1	3	3	2	2	3		3	3		3	3	3
<i>P. mirabilis</i>	%S	100	85	90	97	88	99	96	99	99	75	100	91		79	100	R	100	81	91
	Total Isolates	1552	2438	2375	582	2214	2420	948	2340	2420	2234	608	2439		2439	1876		2438	2438	2401
	Total Facilities	9	14	13	4	13	13	5	12	13	12	5	14		14	11		14	14	14
	Range % S*	100-100	79-90	84-94	90-100	2-98	95-100	95-97	95-100	95-100	0-84	98-100	84-96		71-86	99-100		98-100	73-100	84-96
	# Facilities Included in Range	7	12	12	4	11	12	5	11	12	11	4	12		12	9		12	12	12
<i>S. marcescens</i>	%S	100	R	R	99	R	99	R	98	95	96	99	97		97	100	R	97	96	89
	Total Isolates	372			148		464		456	453	429	157	464		463	442		398	464	455
	Total Facilities	5			3		7		7	7	6	4	7		7	7		5	7	7
	Range % S*	98-100			97-100		94-100		91-100	91-100	93-100	94-100	91-100		94-100	100-100		95-100	91-100	85-96
	# Facilities Included in Range	4			3		6		6	6	5	3	6		6	6		5	6	6

R = intrinsic resistance

\* Range only reported when more than one facility and ≥30 isolates per facility

## Gram-Positive

### *Enterococcus* spp.

		Ampicillin	Daptomycin	Linezolid	Penicillin	Vancomycin
<i>E. faecalis</i>	%S	100	95	99	100	100
	Total Isolates	3821	922	3959	3664	4572
	Total Facilities	9	4	9	6	11
	Range % S*	98-100	89-100	95-100	99-100	97-100
	# Facilities Included in Range	8	4	8	6	10
<i>E. faecium</i>	%S	15	63	99	16	40
	Total Isolates	751	154	944	873	1040
	Total Facilities	4	1	6	4	6
	Range % S*	11-34	-	96-100	10-31	26-57
	# Facilities Included in Range	4	1	6	4	6
<i>Enterococcus</i> spp. ***	%S	94	87	100	86	93
	Total Isolates	1321	1108	2429	826	2429
	Total Facilities	3	2	5	1	5
	Range % S*	93-96	82-100	100-100	-	88-97
	# Facilities Included in Range	3	2	5	1	5

\* Range only reported when more than one facility and  $\geq 30$  isolates per facility

\*\*\* May include isolates from *E. faecalis* and/or *E. faecium*

*Staphylococcus aureus*

		Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Gentamicin	Levofloxacin	Linezolid	Minocycline	Oxacillin	Penicillin	Rifampin	Trimethoprim-Sulfamethoxazole	Tetracycline	Vancomycin
MRSA	%S	30	58	100	97	14	97	32	100				99	94	93	100
	Total Isolates	1879	2267	365	145	1790	1893	2245	2442				500	2458	2323	2456
	Total Facilities	5	8	2	2	6	6	7	7				3	8	7	8
	Range % S*	27-50	49-87	-	-	7-18	91-100	28-51	100-100				98-100	90-98	91-100	100-100
	# Facilities Included in Range	5	7	1	1	5	5	6	7				2	7	6	7
MSSA	%S	88	79	100	97	69	99	90	100		100	0	99	95	93	100
	Total Isolates	5126	5568	567	364	4142	4779	5694	5855		5329	4936	931	5871	5506	5883
	Total Facilities	6	7	1	1	5	5	7	7		9	5	2	7	6	7
	Range % S*	86-93	76-86	-	-	67-81	98-100	89-96	100-100		99-100	0-0	99-100	93-100	92-97	100-100
	# Facilities Included in Range	6	7	1	1	5	5	7	7		9	5	2	7	6	7
<i>S. aureus</i> ****	%S	88	76	99	96	55	99	75	100	97	71	19	100	97	94	100
	Total Isolates	16	3230	1359	1017	1907	1907	3230	2852	981	3230	16	3230	3230	1907	3230
	Total Facilities	1	7	3	2	5	5	7	5	1	7	1	7	7	5	7
	Range % S*		74-77	98-100	96-100	51-61	99-100	67-94	100-100	-	63-100		97-100	94-99	94-97	100-100
	# Facilities Included in Range	0	6	3	2	4	4	6	4	1	6	0	6	6	4	6

R = intrinsic resistance

MRSA = methicillin-resistant *Staphylococcus aureus*

MSSA = methicillin-susceptible *Staphylococcus aureus*

\* Range only reported when more than one facility and ≥30 isolates per facility

\*\*\*\* May include MRSA and MSSA isolates



Group B *Streptococcus*

		Ampicillin	Cefotaxime	Ceftriaxone	Clindamycin	Erythromycin	Levofloxacin	Linezolid	Penicillin	Vancomycin
Group B <i>Streptococcus</i>	%S	100	100	100	53	43	97	100	100	100
	Total Isolates	1810	1680	1944	1937	1765	30	30	1982	2042
	Total Facilities	7	5	10	9	8	1	1	10	11
	Range % S*	100-100	100-100	100-100	41-58	36-50	-	-	100-100	100-100
	# Facilities Included in Range	7	5	10	9	8	1	1	10	11

*Streptococcus pneumoniae*

		Ceftriaxone	Clindamycin	Doxycycline	Erythromycin	Levofloxacin	Linezolid	Meropenem	Penicillin	Trimethoprim-Sulfamethoxazole	Tetracycline	Vancomycin
<i>S. pneumoniae</i>	%S	97	91	84	47	98	100	96	88	85	90	100
	Total Isolates	320	244	55	55	319	40	69	317	146	117	535
	Total Facilities	5	5	1	1	6	1	3	5	3	3	8
	Range % S*	94-100	88-93	-	-	97-100	-	-	76-100	73-97	88-93	97-100
	# Facilities Included in Range	3	3	1	1	5	1	1	3	3	2	6

\* Range only reported when more than one facility and ≥30 isolates per facility