

# 2019 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 provide MDH with a tool to track trends in the percent of clinical bacterial isolates susceptible to selected antibiotic drugs. Antibiograms are available at [Minnesota Antibiotic Stewardship Data \(www.health.state.mn.us/diseases/antibioticresistance/data.html\)](http://www.health.state.mn.us/diseases/antibioticresistance/data.html), with data first compiled for isolates collected in 2018.

## Methodology

A total of 41 antibiograms reflecting isolates collected during 2019, were submitted to MDH. Of these, 36 were included in the statewide antibiogram. Antibiograms were submitted in a variety of formats, including PDF, Microsoft Word, and Microsoft Excel. Submitted antibiograms were excluded from the statewide summary if they did not include isolate counts, had an unclear date range, or included only data collected outside of the year of interest. Selected data from included antibiograms were excluded if the number of isolates tested for an individual organism-antibiotic drug combination could not be determined. Antibiogram submitters were contacted by email up to three times for clarification. If the data in question could not be confirmed through those queries, they were excluded from the statewide summary.

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) and a weighted average susceptibility was calculated for submitted antibiograms.

The total 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 organism-antibiotic combination (number of isolates x percent susceptible); 2) summing the number of susceptible isolates across all institutions for each organism-antibiotic combination; 3) summing the total number of isolates across all institutions for each organism-antibiotic combination; and 4) dividing the summed number of susceptible isolates by the total number of isolates to get an overall percent susceptible for each organism-antibiotic 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.

<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/antimicrobial-resistance/media/pdfs/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 statewide antibiogram has several limitations. Because of these limitations and geographic variation that cannot be accounted for in this antibiogram, information in this document should not be used to inform clinical treatment decisions. The report and data included in subsequent statewide antibiograms will be used to understand changes in the susceptibility patterns of clinically important bacterial organisms over time.

- Data reflect isolates from a subset of hospitals and might not be generalizable to all of Minnesota.
- The 2019 statewide antibiogram includes data from 52 hospitals, some of which are not in Minnesota. Small and critical-access hospitals make up approximately 60% of Minnesota’s 128 hospitals. These hospitals often utilize antibiograms that have been compiled by a health system or laboratory to include isolates from several small hospitals and, in some cases, other settings.
- Four submitted antibiograms (11%) included results from multiple hospitals. Antibiogram data for organism-antibiotic combinations reflect the number of submitted antibiograms rather than the number of contributing hospitals.
- Some submitted antibiograms include isolates collected from outside of the January–December 2019 time frame, because additional time was needed to reach 30 isolates.
- Susceptibility testing methodologies differed across submitted antibiograms. CLSI breakpoints for all organism-antibiotic combinations were used by 23/36 (64%) laboratories that generated included antibiograms, and 4/36 (11%) used CLSI breakpoints for most combinations. Of the laboratories using CLSI breakpoints, 12/27 (44%) used current breakpoints for all organism-antibiotic combinations. Some submitters (7/36, 19%) did not know if CLSI breakpoints were used.
- Not all contributing hospitals followed CLSI M39<sup>3</sup> guidelines for generating their facility antibiogram. The table below summarizes select antibiogram compilation characteristics for submitted antibiograms.

Antibiogram Characteristics, Based on CLSI M39 Guidelines	Count (%) N=36
Includes only final, verified results.	32 (89%)
Includes only the first isolate of a given species per patient per antibiogram period.	25 (69%)
Includes results hidden from clinical view through cascaded reporting.	25 (69%)
Includes only results for organisms with ≥30 isolates.	17 (47%)
Susceptibility percentage calculated using only "susceptible," not "intermediate," interpretation.	29 (81%)
Includes only isolates from a single health care facility (i.e., facility-specific antibiogram).	32 (89%)

<sup>3</sup> Clinical and Laboratory Standards Institute. Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data. CLSI guideline M39. 5th ed. Clinical and Laboratory Standards Institute; 2022.

## Contents

Background ..... 1

Methodology ..... 1

Limitations ..... 2

Gram-Negative ..... 3

Gram-Positive ..... 7



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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	96	90	R	81	81	51	84	88	100	88	90	81	87	94
	Total Isolates	195	260		257	306	166	305	308	21	297	282	224	246	299
	Total Antibiograms	3	7		7	9	6	10	10	1	8	8	6	8	9
	Range % S*	94-99	78-97		65-95	78-91	57-69	77-93	78-96		79-95	86-97	65-100	86-89	91-100
	# Antibiograms Included in Range	3	4		4	4	2	4	4		4	4	3	3	4
<i>P. aeruginosa</i>	%S	91	R	80	90	90	R	84	89	89	80	91	89		97
	Total Isolates	5394		1577	6494	6367		6766	6080	2253	6773	6009	6670		6660
	Total Antibiograms	22		11	31	32		34	34	18	35	29	31		33
	Range % S*	0-100		71-87	74-98	77-96		72-95	75-98	80-94	71-92	82-100	74-100		91-100
	# Antibiograms Included in Range	19		10	25	25		27	26	13	27	23	26		26
<i>S. maltophilia</i>	%S		R	R		30	R		R	R	79	R	R	96	R
	Total Isolates					963					1021			1021	
	Total Antibiograms					12					14			14	
	Range % S*					18-53					60-97			92-100	
	# Antibiograms Included in Range					8					9			9	

R = intrinsic resistance

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

2019 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	99	87	60	65	94	91	97		95	96	96	95	83	100		94	100	81	100		97	80	80	88
	Total Isolates	37349	11084	47575	45266	12335	40833	46283		17157	46689	51514	6823	47914	17329		48022	14051	50740	42400		50650	51718	51718	47613
	Total Antibiograms	21	11	32	30	11	30	30		13	31	34	8	32	20		33	16	34	28		32		35	31
	Range % S*	98-100	80-95	35-85	54-85	87-99	66-96	89-100		91-97	88-100	85-100	88-96	73-96	99-100		88-97	99-100	73-89	99-100		85-100	48-94	48-94	14-97
	# Antibiograms Included in Range	21	11	32	30	11	30	30		13	31	34	8	32	20		33	15	34	28		31	35	35	31
<i>E. coli</i> (urine only)	%S	100		59	65	88	85	95			95	93		85	99	99	94		82	99	96	97	80	80	94
	Total Isolates	1610		2926	1907	591	3778	2926			2926	2926		2926	2042	591	2926		2042	1610	7351	2926	2926	2926	2926
	Total Antibiograms	2		4	3	1	5	4			4	4		4	3	1	4		3	2	7	4		4	4
	Range % S*	100-100		53-72	59-79	88	68-94	90-99			89-98	86-97		76-90	99-100	99	91-96		74-88	99	95-99	97-98	75-87	75-87	89-96
	# Antibiograms Included in Range	2		4	3	1	5	4			4	4		4	3	1	4		3	2	7	4		4	4

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

2019 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	86	R	99	R	81	81	99	97	100		96	99	15	82	98	100
	Total Isolates	789			315		994		961	1039	994	433	944		1043	930	616	1022	1060	972
	Total Antibiograms	14			7		19		18	20	19	11	19		20	17	11	18	21	19
	Range % S*	100-100			73-100		95-100		65-95	64-94	95-100	92-100	96-100		92-100	97-100	3-23	69-97	94-100	98-100
	# Antibiograms Included in Range	12			5		14		14	15	14	8	13		15	14	9	15	15	14
<i>Klebsiella</i> spp. **	%S		R	93		100	98		89	89	98	100	97	96	96		57	91	97	97
	Total Isolates			158		66	158		158	158	158	66	158	158	158		100	158	158	158
	Total Antibiograms			2		1	2		2	2	2	1	2	2	2		2	2	2	2
	Range % S*			93-93		100	97-100		82-100	80-100	97-100	100	97-98	93-100	96-97		40-69	84-100	97-97	97-97
	# Antibiograms Included in Range			2		1	2		2	2	2	1	2	2	2		2	2	2	2
<i>K. oxytoca</i>	%S	100	R	61	95	52	98	97	98	97	98	100	98	100	98	100	88	95	94	94
	Total Isolates	1774		2061	693	1962	2228	465	2126	2350	2228	862	2185	715	2240	1899	1388	2322	2353	2191
	Total Antibiograms	18		23	9	23	25	9	25	28	25	15	26	12	26	23	22	25	28	25
	Range % S*	100-100		46-74	88-100	21-72	91-100	93-100	91-100	88-100	91-100	99-100	95-100	98-100	94-100	98-100	75-94	88-100	86-100	0-100
	# Antibiograms Included in Range	16		17	7	17	20	5	19	21	20	10	19	9	19	17	16	21	21	19
<i>K. pneumoniae</i>	%S	100	R	86	94	94	97	96	96	96	97	99	97	99	94	100	42	97	92	91
	Total Isolates	6521		7444	2304	7274	7391	2656	7854	8544	7391	3244	7847	2461	8357	7209	6402	8400	8565	8053
	Total Antibiograms	22		30	12	31	29	13	31	34	29	19	33	16	33	28	29	32	35	31
	Range % S*	95-100		74-97	91-100	81-100	88-100	93-100	88-100	88-100	88-100	94-100	68-100	98-100	74-100	88-100	24-73	88-100	61-100	0-100
	# Antibiograms Included in Range	20		26	11	28	26	10	28	31	26	17	29	12	29	24	24	29	31	28

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*

Other Gram-Negative Species

		Amikacin	Ampicillin	Ampicillin/ Sulbactam	Aztreonam	Cefepime	Cefoxitin	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin- Tazobactam	Trimethoprim- Sulfamethoxazole	Tobramycin
Citrobacter spp. **	%S	100	R		85	99		83	82	93	98	95	96	92	99	91	87	89	92
	Total Isolates	1417			460	1759		1761	1817	1725	867	1618	604	1778	1581	1256	1770	1802	1704
	Total Antibiograms	17			8	26		26	28	27	15	26	13	26	21	23	25	25	25
	Range % S*	97-100			78-92	97-100		76-90	74-92	87-98	95-100	85-100	88-100	85-100	99-100	70-100	79-96	80-96	0-100
	# Antibiograms Included in Range	15			6	18		18	19	18	10	17	7	18	16	17	19	19	17
Enterobacter spp.	%S	100	R	R	81	96	R	81	78	96	93	98	89	95	99	35	82	93	96
	Total Isolates	2409			951	2987		2893	3113	2978	1273	2857	1070	3012	2488	1578	3103	3135	2972
	Total Antibiograms	19			10	28		27	29	29	16	28	15	28	20	21	28	30	26
	Range % S*	99-100			71-90	89-100		69-93	66-88	91-100	85-100	95-100	69-100	88-100	96-100	11-51	71-95	85-98	50-100
	# Antibiograms Included in Range	18			8	22		21	23	22	11	21	10	21	17	17	23	23	21
M. morganii	%S	100	R	6	93	99	40	84	90	83	99	87		84	100	R	97	80	91
	Total Isolates	236		192	97	267	50	283	280	249	99	293		267	288		280	293	282
	Total Antibiograms	4		4	2	5	1	5	5	5	3	6		5	6		5	6	6
	Range % S*	98-100		4-10	90-95	97-100	40	80-90	87-95	76-88	98-100	83-94		76-93	100-100		95-98	72-85	88-98
	# Antibiograms Included in Range	3		2	2	4	1	4	4	3	2	4		4	4		4	4	4
P. mirabilis	%S	100	84	90	98	98	97	98	98	80	99	91	54	81	100	R	99	84	87
	Total Isolates	3074	3821	3547	1218	3944	1136	3872	4251	3900	1700	3865	315	4126	3235		4180	4257	3978
	Total Antibiograms	21	31	28	11	29	12	29	33	32	19	32	8	32	23		31	34	30
	Range % S*	99-100	77-92	79-95	86-100	81-100	89-100	84-100	88-100	67-100	90-100	86-100	18-100	67-100	99-100		90-100	71-95	0-100
	# Antibiograms Included in Range	17	22	20	8	23	8	23	25	24	13	23	4	23	17		24	25	23
S. marcescens	%S	99	R	R	98	98	R	97	93	91	98	98	82	92	99	R	94	96	88
	Total Isolates	794			252	946		926	957	904	359	894	85	893	857		869	938	956
	Total Antibiograms	13			4	15		15	16	15	8	14	2	14	13		13	15	16
	Range % S*	95-100			97-100	96-100		88-100	85-100	69-100	94-100	88-100	58-100	67-100	96-100		80-100	89-100	78-100
	# Antibiograms Included in Range	10			4	13		12	13	12	6	11	2	11	11		12	12	13

R = intrinsic resistance

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

\*\*Susceptibility was calculated across any Citrobacter species reported. Some hospitals reported only *C. freundii*.

## Gram-Positive

### *Enterococcus* spp.

		Ampicillin	Daptomycin	Linezolid	Penicillin	Vancomycin
<i>E. faecalis</i>	%S	100	94	100	100	100
	Total Isolates	6580	2358	6099	6044	7418
	Total Antibiograms	29	12	26	23	32
	Range % S*	99-100	62-100	95-100	95-100	99-100
	# Antibiograms Included in Range	23	10	21	20	26
<i>E. faecium</i>	%S	19	99	97	20	44
	Total Isolates	1011	162	1280	1097	1339
	Total Antibiograms	17	5	16	12	18
	Range % S*	10-39	100-100	86-100	10-34	31-62
	# Antibiograms Included in Range	8	2	8	6	9
<i>Enterococcus</i> spp.***	%S	92		100	86	89
	Total Isolates	1014		1291	1484	2079
	Total Antibiograms	3		3	3	5
	Range % S*	91-93		100-100	84-90	80-94
	# Antibiograms Included in Range	3		3	3	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*

2019 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

*Staphylococcus aureus*

		Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Gentamicin	Levofloxacin	Linezolid	Minocycline	Oxacillin	Penicillin	Rifampin	Trimethoprim-Sulfamethoxazole	Tetracycline	Vancomycin
MRSA	%S	36	67	100	91	14	98	39	100				99	95	92	100
	Total Isolates	3971	5444	2166	610	4928	4700	4611	4872				2487	5625	5341	5620
	Total Antibiograms	19	28	12	4	25	25	22	23				16	28	26	27
	Range % S*	25-60	46-92	99-100	87-94	5-25	93-100	26-64	99-100				97-100	90-100	84-100	90-100
	# Antibiograms Included in Range	15	22	9	3	20	19	17	18				11	22	21	22
MSSA	%S	88	80	100	96	69	99	90	100		100	19	99	95	94	100
	Total Isolates	8050	9933	3570	1447	9068	7878	8956	9033		9696	3489	3863	10307	9474	10285
	Total Antibiograms	19	25	11	4	24	21	21	21		23	11	14	25	23	24
	Range % S*	82-95	68-99	99-100	94-99	42-80	97-100	86-99	99-100		97-100	0-32	99-100	89-100	90-97	97-100
	# Antibiograms Included in Range	16	22	10	4	21	18	18	18		20	10	12	22	21	22
<i>S. aureus</i> ****	%S	78	78	100	96	55	97	77	100	97	72	8	99	96	93	100
	Total Isolates	3409	7005	2289	2369	5555	4974	4034	5938	1267	5245	306	6047	7113	5664	7114
	Total Antibiograms	8	14	5	4	12	11	9	13	1	11	2	12	14	12	14
	Range % S*	70-88	70-93	99-100	94-97	42-66	88-99	72-81	100-100	97	65-76	7	98-100	90-99	88-98	99-100
	# Antibiograms Included in Range	6	12	4	4	10	9	7	11	1	9	1	10	12	10	12

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	51	42	99	100	100	100
	Total Isolates	2018	1947	2230	2295	2076	351	88	2403	2385
	Total Antibiograms	15	13	16	20	15	10	5	19	20
	Range % S*	100-100	100-100	98-100	25-60	36-47	98-100	100	100-100	100-100
	# Antibiograms Included in Range	8	8	12	12	10	3	1	13	12

*Streptococcus pneumoniae*

		Ceftriaxone	Clindamycin	Doxycycline	Erythromycin	Levofloxacin	Linezolid	Meropenem	Penicillin (meningitis)	Penicillin (non-meningitis)	Trimethoprim-Sulfamethoxazole	Tetracycline	Vancomycin
<i>S. pneumoniae</i>	%S	99	87	60	59	99	100	94	71	97	80	88	100
	Total Isolates	780	762	96	729	934	43	235	869	871	782	471	958
	Total Antibiograms	15	15	1	14	18	3	7	13	13	16	12	18
	Range % S*	98-100	80-94	60	50-68	97-100	100	89-96	63-80	90-100	65-90	81-94	100-100
	# Antibiograms Included in Range	10	7	1	9	11	1	2	11	11	10	7	12

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