

2020 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.¹ Minnesota Department of Health (MDH) conducts surveillance for antibiotic-resistant organisms of public health concern and reports on these organisms annually.² 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 2020, were submitted to MDH. Of these, 38 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.

¹ 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>.

² 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 2020 statewide antibiogram includes data from 59 hospitals, some of which are not in Minnesota. Small and critical-access hospitals make up approximately 60% of Minnesota's 127 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 2020 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 23/38 (61%) laboratories that generated included antibiograms, and 5/38 (13%) used CLSI breakpoints for most combinations. Of the laboratories using CLSI breakpoints, 12/28 (43%) used current breakpoints for all organism-antibiotic combinations. Some submitters (8/38, 21%) did not know if CLSI breakpoints were used.
- Not all contributing hospitals followed CLSI M39³ 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=38
Includes only final, verified results.	34 (90%)
Includes only the first isolate of a given species per patient per antibiogram period.	26 (68%)
Includes results hidden from clinical view through cascaded reporting.	26 (68%)
Includes only results for organisms with ≥30 isolates.	18 (47%)
Susceptibility percentage calculated using only "susceptible," not "intermediate," interpretation.	30 (79%)
Includes only isolates from a single health care facility (i.e., facility-specific antibiogram).	34 (89%)

³ 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.

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Minnesota Department of Health
Infectious Diseases Epidemiology, Prevention and Control Division
PO Box 64974, St. Paul, MN 55164-0975
651-201-5414 | 1-877-676-5414
health.stewardship@state.mn.us

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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	99	94	R	88	87	59	92	93	100	94	95	84	92	93
	Total Isolates	203	267		248	301	158	301	301	22	301	279	158	229	301
	Total Antibiograms	4	7		6	10	5	10	10	2	10	8	5	8	10
	Range % S*	94-100	83-97		79-91	81-91	62-65	87-96	89-96		87-100	89-99	79-86	88-95	88-100
	# Antibiograms Included in Range	3	4		4	4	2	4	4		4	4	2	3	4
<i>P. aeruginosa</i>	%S	95	R	80	90	91	R	83	89	87	79	90	89	R	98
	Total Isolates	5065		1429	6589	6601		6616	6139	2287	6710	5804	6741		6848
	Total Antibiograms	21		11	35	35		36	35	17	37	29	32		36
	Range % S*	50-100		72-91	84-100	83-100		76-100	75-100	55-100	69-94	82-99	67-100		93-100
	# Antibiograms Included in Range	19		8	29	29		30	28	14	30	24	29		30
<i>S. maltophilia</i>	%S		R	R		31	R		R	R	87	R	R	93	R
	Total Isolates					885					899			943	
	Total Antibiograms					12					13			14	
	Range % S*					13-48					83-97			79-100	
	# Antibiograms Included in Range					10					10			11	

R = intrinsic resistance

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

2020 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	88	60	66	94	91	97		95	96	96	96	82	100		94	100	81	100		97		81	89
	Total Isolates	29062	11599	42609	41879	13106	38249	42659		16774	41940	46632	4954	44009	17084		43535	13683	46722	38797		45842		46764	44914
	Total Antibiograms	20	11	32	31	12	32	34		12	33	36	6	35	22		34	16	37	29		34		37	34
	Range % S*	98-100	81-100	48-69	57-76	90-100	68-97	88-100		91-97	91-100	88-100	78-100	72-100	99-100		91-100	99-100	72-100	99-100		91-100		73-100	18-100
	# Antibiograms Included in Range	19	11	31	30	12	31	33		10	31	35	6	34	22		33	16	36	28		33		36	33
<i>E. coli</i> (urine only)	%S	100		61	65	94	89	94			94	93		80	100	100	93		80	99	96	97		80	94
	Total Isolates	3084		3478	3866	1993	6626	4951			4951	4951		4951	4951	1993	3478		4951	4551	9366	4951		4951	4951
	Total Antibiograms	3		4	4	2	7	5			5	5		5	5	2	4		5	4	9	5		5	5
	Range % S*	99-100		57-67	63-77	91-95	71-95	92-96			92-96	89-95		74-87	99-100	99-100	91-94		74-87	99-100	95-98	96-99		76-84	91-95
	# Antibiograms Included in Range	3		4	4	2	7	5			5	5		5	5	2	4		5	4	9	5		5	5

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

2020 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

Klebsiella spp.

		Amikacin	Ampicillin	Ampicillin/ Subbactam	Aztreonam	Cefazolin	Cefepime	Cefoxitin	Ceftazidime	Ceftriaxone	Ciprofloxacin	Ertapenem	Gentamicin	Imipenem	Levofloxacin	Meropenem	Nitrofurantoin	Piperacillin- Tazobactam	Trimethoprim- Sulfamethoxazole	Tobramycin
<i>K. aerogenes</i>	%S	90	R		84	R	99	R	81	80	99	97	100		97	99	16	82	98	92
	Total Isolates	753			311		1026		1030	1100	1026	466	1012		1101	963	720	1116	1133	1093
	Total Antibiograms	12			6		20		18	20	20	12	20		21	16	14	19	22	20
	Range % S*	0-100			72-100		96-100		73-100	71-100	96-100	91-100	95-100		93-100	94-100	8-22	72-100	96-100	0-100
	# Antibiograms Included in Range	10			5		14		14	15	14	8	14		15	13	8	16	16	15
<i>Klebsiella</i> spp. **	%S		R	86		93	96		96	96	96	100	100	100	95		35	96	96	100
	Total Isolates			56		56	56		56	56	56	56	56	56	56		46	56	56	56
	Total Antibiograms			1		1	1		1	1	1	1	1	1	1		1	1	1	1
	Range % S*			86		92	96		96	96	96	100	100	100	95		35	96	96	100
	# Antibiograms Included in Range			1		1	1		1	1	1	1	1	1	1		1	1	1	1
<i>K. oxytoca</i>	%S	100	R	60	93	45	97	97	97	95	97	99	98	99	98	100	85	95	95	93
	Total Isolates	1593		2253	861	2098	2334	729	2242	2478	2334	1109	2315	831	2381	1933	1531	2436	2478	2405
	Total Antibiograms	17		26	10	27	29	10	28	31	29	18	29	13	30	23	23	29	31	29
	Range % S*	100-100		43-79	90-98	22-71	89-100	97-100	91-100	86-100	89-100	98-100	93-100	97-100	90-100	98-100	75-100	91-100	85-99	0-100
	# Antibiograms Included in Range	13		20	8	19	21	6	21	23	21	13	21	10	22	17	14	23	23	22
<i>K. pneumoniae</i>	%S	100	R	87	96	94	97	96	97	96	97	99	98	99	93	100	36	97	92	94
	Total Isolates	5800		7681	2642	7374	7594	3024	7855	8570	7594	3678	7857	2798	8314	7107	6506	8416	8587	8310
	Total Antibiograms	21		32	11	32	33	11	32	36	33	22	34	16	36	28	29	34	37	34
	Range % S*	99-100		74-95	93-100	79-100	83-100	94-100	86-100	83-100	83-100	99-100	83-100	93-100	86-100	97-100	14-60	88-100	83-100	49-100
	# Antibiograms Included in Range	18		28	11	29	30	10	29	33	30	20	31	15	32	24	27	30	33	30

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*

2020 MINNESOTA STATEWIDE ACUTE CARE ANTIBIOGRAM

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	21	81	80	93	99	95	96	92	100	91	87	89	93
	Total Isolates	1086			489	1562	81	1595	1639	1474	813	1461	515	1637	1432	1096	1599	1635	1596
	Total Antibiograms	14			9	27	3	26	28	26	17	26	11	28	21	20	25	27	26
	Range % S*	100-100			73-100	95-100	29	62-95	66-95	85-100	98-100	87-100	89-100	83-100	98-100	80-100	80-97	79-95	16-100
	# Antibiograms Included in Range	12			7	17	1	17	18	16	10	16	7	18	15	14	18	18	17
Enterobacter spp.	%S	100	R	R	82	95	R	80	76	95	92	98	94	94	98	33	82	92	94
	Total Isolates	2116			1121	3203		3073	3312	3012	1567	3078	1155	3193	2609	1831	3271	3324	3218
	Total Antibiograms	18			10	33		31	33	32	20	31	16	32	25	24	31	34	31
	Range % S*	99-100			75-90	87-100		71-90	66-90	88-100	78-100	95-100	90-100	85-100	92-100	16-56	73-95	85-98	0-100
	# Antibiograms Included in Range	14			8	22		21	23	21	13	21	10	22	17	17	23	23	22
M. morganii	%S	100	R	7	95	98	48	87	85	86	98	90		85	100	R	98	81	94
	Total Isolates	293		183	191	344	97	374	374	293	191	374		332	332		374	374	374
	Total Antibiograms	5		3	4	6	1	7	7	5	4	7		6	6		7	7	7
	Range % S*	100-100		5-10	91-98	95-100	48	80-100	73-100	80-91	93-100	77-96		71-100	100-100		95-100	68-90	75-98
	# Antibiograms Included in Range	5		3	4	6	1	7	7	5	4	7		6	6		7	7	7
P. mirabilis	%S	100	84	90	96	98	96	98	98	81	100	91	36	83	100	R	100	84	88
	Total Isolates	2751	3839	3931	1452	4113	1295	3975	4346	3897	2058	3911	357	4136	3148		4308	4352	4199
	Total Antibiograms	19	32	30	13	33	10	31	35	33	22	34	7	35	22		33	36	33
	Range % S*	97-100	74-100	79-100	90-100	89-100	86-100	90-100	90-100	57-100	96-100	63-100	5-90	60-100	98-100		96-100	70-97	7-100
	# Antibiograms Included in Range	17	26	25	10	28	9	28	30	28	18	28	5	29	19		30	30	29
S. marcescens	%S	99	R	R	97	99	R	94	91	93	98	98	89	91	99	R	92	97	87
	Total Isolates	717			348	1009		997	1037	945	503	958	158	1005	827		892	1005	1038
	Total Antibiograms	13			7	19		18	19	18	13	18	4	19	15		15	19	20
	Range % S*	97-100			91-100	92-100		76-100	68-100	84-100	94-100	94-100	67-100	80-100	97-100		69-100	94-100	81-97
	# Antibiograms Included in Range	9			7	16		15	16	14	10	14	4	15	11		13	15	16

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	93	99	99	100
	Total Isolates	7218	2114	6813	6138	8296
	Total Antibiograms	33	11	29	26	36
	Range % S*	96-100	52-100	91-100	91-100	97-100
	# Antibiograms Included in Range	30	10	25	22	33
<i>E. faecium</i>	%S	20	77	94	19	44
	Total Isolates	1281	203	1406	1253	1550
	Total Antibiograms	19	5	19	11	21
	Range % S*	10-49	0-100	70-100	10-49	28-78
	# Antibiograms Included in Range	11	3	11	7	13
Enterococcus spp. ***	%S		58	99	85	89
	Total Isolates		549	535	870	1314
	Total Antibiograms		1	1	1	2
	Range % S*		58	99	85	87-92
	# Antibiograms Included in Range		1	1	1	2

* Range only reported when more than one facility and ≥ 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	34	67	100	91	14	97	37	100	93			98	94	92	100
	Total Isolates	3294	5555	2251	1567	4199	3905	4978	4660	902			3487	5768	4514	5756
	Total Antibiograms	20	30	14	6	28	26	26	27	1			20	31	27	30
	Range % S*	10-54	55-87	99-100	88-94	0-30	91-100	18-61	100-100	93			95-99	89-100	83-96	92-100
	# Antibiograms Included in Range	14	21	10	5	19	17	18	19	1			12	22	19	22
MSSA	%S	88	83	100	96	73	99	91	100	98	100	16	99	96	93	100
	Total Isolates	6705	8734	3878	1823	7422	6283	8106	7955	267	8939	3434	3939	8939	7659	8915
	Total Antibiograms	18	25	12	6	22	19	22	20	1	25	12	15	25	21	24
	Range % S*	80-98	68-96	99-100	93-100	51-83	98-100	84-100	99-100	98	98-100	0-36	94-100	90-100	84-98	99-100
	# Antibiograms Included in Range	15	22	11	6	19	16	19	17	1	22	10	12	22	19	22
<i>S. aureus</i> ****	%S	71	80	100	95	53	98	74	100	97	70	8	99	96	93	99
	Total Isolates	2667	7122	2347	2491	5474	5591	5005	6476	1159	5573	614	6013	7240	5592	7240
	Total Antibiograms	9	17	7	4	15	15	12	16	1	14	4	14	17	15	17
	Range % S*	61-85	70-87	99-100	93-96	40-63	95-100	59-84	100-100	97	53-79	0-25	97-100	90-100	83-97	95-100
	# Antibiograms Included in Range	7	15	6	4	13	13	10	14	1	12	3	12	15	13	15

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	54	44	98	99	100	100
	Total Isolates	1867	1840	2155	2108	2075	436	196	2268	2166
	Total Antibiograms	16	13	18	20	17	11	6	21	20
	Range % S*	98-100	96-100	98-100	44-62	36-50	97-100	100-100	96-100	100-100
	# Antibiograms Included in Range	9	9	15	13	12	5	2	16	13

Streptococcus pneumoniae

		Ceftriaxone	Clindamycin	Doxycycline	Erythromycin	Levofloxacin	Linezolid	Meropenem	Penicillin (meningitis)	Penicillin (non-meningitis)	Trimethoprim-Sulfamethoxazole	Tetracycline	Vancomycin
<i>S. pneumoniae</i>	%S	98	89	75	57	99	100	93	70	96	81	88	100
	Total Isolates	583	475	81	553	681	107	191	631	631	634	389	608
	Total Antibiograms	15	14	1	16	18	5	5	12	12	18	13	16
	Range % S*	95-100	80-100	75	43-70	97-100	100-100	86-98	58-86	72-100	70-87	79-100	100-100
	# Antibiograms Included in Range	10	8	1	9	11	2	3	11	11	11	8	10

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