

2018 VIRGINIA STATE AND REGIONAL CUMULATIVE ANTIBIOGRAM

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Executive Summary

Antimicrobial resistance is a public health crisis that must be managed with the utmost urgency. According to the CDC's [2019 AR Threats Report](#), more than 2.8 million antibiotic-resistant infections occur in the United States each year, and more than 35,000 people die as a result. The annual Virginia State and Regional Cumulative Antibigram was created to report on antimicrobial resistance trends in Virginia. The majority of hospitals in Virginia voluntarily submitted 2018 data to VDH for inclusion in this report.

Virginia 2018 data reveal levels of resistance consistent with national trends, which have been steadily increasing. *Acinetobacter baumannii* continued to be one of the most resistant Gram-negative bacteria. Among other Gram-negative bacteria, resistance varied slightly depending on specimen source and geographic location. For Gram-positive bacteria, *Enterococcus faecium* had limited treatment options due to the resistant nature of this organism. *Staphylococcus aureus* was the Gram-positive organism with the most isolates tested by facilities in 2018. The percentage of methicillin-resistant *Staphylococcus aureus* has remained stable.

The Virginia Healthcare-Associated Infections (HAI) Advisory Group continues to work with partner organizations, key stakeholders, and healthcare facilities to improve existing antimicrobial stewardship programs and develop new strategies to reduce the number of infections caused by multidrug-resistant organisms in Virginia.

Purpose and Public Health Implications

Antimicrobial resistance is a global public health concern. Facility-level antibiograms provide a summary of the percentage of isolates susceptible to a variety of antimicrobial agents within a healthcare facility. The facility antibiogram is an important tool for the development of antimicrobial stewardship policies and protocols for empiric antibiotic selection. Facility antibiograms are often limited by the number of organisms tested and the geographic coverage represented. The Virginia HAI Advisory Group, led by the Virginia Department of Health, Health Quality Innovators, and the Virginia Hospital and Healthcare Association, analyzed data from facility-level antibiograms to develop an understanding of antimicrobial susceptibility and resistance among bacteria recovered from clinical specimens across Virginia.

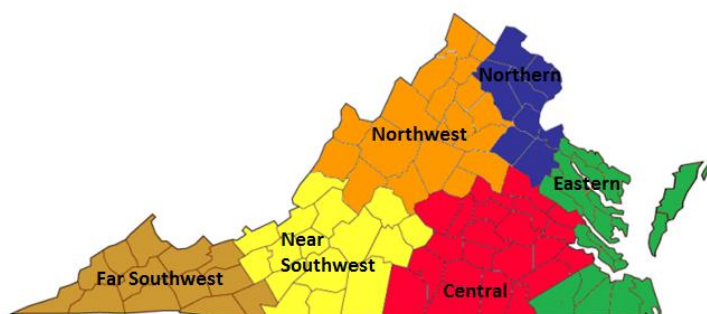
The statewide antibiogram can be used as a baseline to compare local data and can be used by healthcare facilities without access to a local antibiogram (i.e. outpatient care, long-term care, assisted living, ambulatory surgery, etc.) to assist with appropriate antibiotic prescribing. The data and information presented are intended to encourage coordinated antibiotic stewardship efforts statewide to prevent antibiotic resistance and slow the spread of multidrug-resistant organisms.

Methodology

- ❖ Sixty-three of eighty-three (76%) Virginia hospitals voluntarily submitted facility-level antibiograms for their health-systems (Table 1).
- ❖ Data included in the state and regional cumulative antibiogram were based on compilation of data from submitted antibiograms.
 - Not all facilities reported results for all organism/antibiotic combinations.
 - Not all facilities reported results by source, location, and/or practice setting. When indicated, results were compiled as such.
 - Not all facilities used a similar period when reporting data. The state and regional antibiogram reflects organism susceptibility tested from 2016-2018. Sixty-one out of sixty-three (97%) facilities reported results for isolates tested solely in 2018.
- ❖ CLSI recommends preparing an antibiogram for organism and antibiotic combinations that have greater than or equal to 30 isolates tested. Facility data that reported the percent susceptible for less than thirty isolates were included in the cumulative percent susceptible, facility number, and number of isolates. Those data were excluded from the cumulative percent susceptible range.
- ❖ Results were compiled by region according to regions defined by the Virginia Healthcare Emergency Management Program (Figure 1).

Table 1. Participating Facilities

	Number of facilities asked to participate	Number of facilities participated, n (%)
Central	18	15 (83)
Eastern	17	17 (100)
Northern	12	7 (58)
Northwest	9	8 (89)
Far Southwest	10	3 (30)
Near Southwest	17	13 (76)
Statewide	83	63 (76)

Figure 1. Virginia Healthcare Emergency Management Regions

Limitations

Facility-level antibiograms are generally prepared following CLSI M39, which recommends including data from the first isolate/patient/analysis period. Antibiograms do not include data from subsequent isolates on a patient, which may be more resistant than the first isolate. Therefore, percent susceptibility data were likely overestimated in some cases. Preparation of facility-level antibiograms using CLSI M39 guidance and the most recent CLSI breakpoint interpretations was not verified. Therefore, percent susceptibility data could be over- or under-estimated in some cases. **Only 30% of hospitals located in the far southwest participated in sharing their data. Data from this region is not well represented and should be interpreted with caution.**

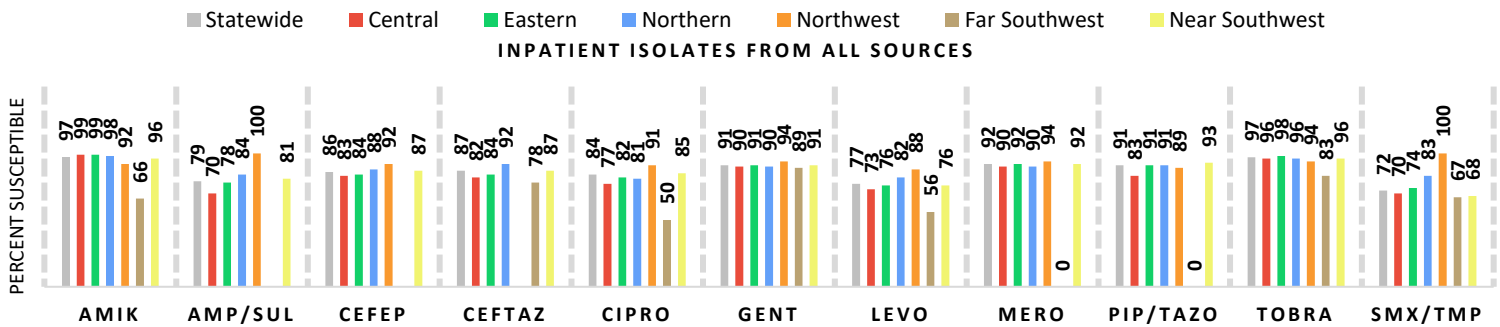
Notes for Interpreting an Antibiogram

The following antibiotics indicate susceptibility to others in the same/related class:

- Oxacillin predicts nafcillin susceptibility
- Tetracycline predicts doxycycline susceptibility
- Erythromycin predicts azithromycin susceptibility
- Ampicillin predicts amoxicillin susceptibility
- Cefazolin predicts cephalexin susceptibility
- Ampicillin/sulbactam predicts amoxicillin/clavulanate susceptibility except for *Acinetobacter spp.*

Acinetobacter baumannii

Acinetobacter is a group of bacteria commonly found in soil and water. *Acinetobacter baumannii* accounts for about 80% of reported *Acinetobacter* infections. Antimicrobial resistance among *Acinetobacter* species has increased substantially in the past decade. In Virginia, ampicillin/sulbactam, meropenem, and aminoglycosides have the highest susceptibilities with some regional variation.

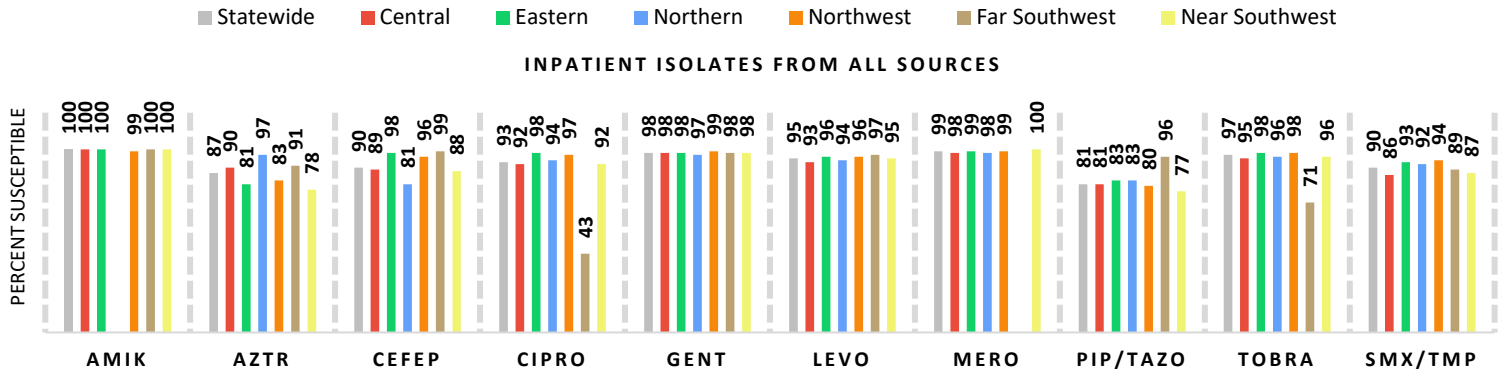


Inpatient isolates from all sources		Amik	Amp/sul	Cefep	Ceftaz	Cipro	Gent	Levo	Mero	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	97%	79%	86%	87%	84%	91%	77%	92%	91%	97%	72%
	# Isolates	3,739	460	5,705	2,618	5,856	4,008	4,459	5,536	5,576	5,678	546
	% S Range*	92-100	57-87	44-97	83-94	47-92	61-100	40-88	76-100	32-100	73-100	47-85
	# Facilities	20	21	35	15	36	37	32	31	25	34	21
Central	% S	99%	70%	83%	82%	77%	90%	73%	90%	83%	96%	70%
	# Isolates	271	61	453	297	453	453	376	365	354	365	109
	% S Range*	-	-	68-96	84-87	66-87	80-97	70-78	92-94	80-97	96-100	-
	# Facilities	4	4	8	5	7	8	7	6	4	6	4
Eastern	% S	99%	78%	84%	84%	82%	91%	76%	92%	91%	98%	74%
	# Isolates	1,004	184	1,330	124	1,277	1,351	1,351	1,147	1,324	1,351	182
	% S Range*	98-100	57-86	44-95	-	47-91	61-99	42-84	76-99	32-100	76-100	58-82
	# Facilities	9	11	12	4	13	13	13	10	9	13	10
Northern	% S	98%	84%	88%	92%	81%	90%	82%	90%	91%	96%	83%
	# Isolates	393	38	528	298	810	554	554	554	468	554	60
	% S Range*	95-100	-	80-89	83-94	75-87	81-96	81-86	85-96	88-98	86-100	-
	# Facilities	4	2	5	3	6	6	6	6	4	6	2
Northwest	% S	92%	100%	92%	-	91%	94%	88%	94%	89%	97%	100%
	# Isolates	212	3	483	-	436	483	224	480	480	436	3
	% S Range*	-	-	90-96	-	90-92	92-95	-	87-100	81-100	94-99	-
	# Facilities	1	1	4	-	3	4	2	3	3	3	1
Far Southwest	% S	66%	-	-	78%	50%	89%	56%	-	-	83%	67%
	# Isolates	18	-	-	18	18	18	18	-	-	18	18
	% S Range*	-	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	-	-	1	1	1	1	-	-	1	1
Near Southwest	% S	96%	81%	87%	87%	85%	91%	76%	92%	93%	96%	68%
	# Isolates	1,841	174	2,911	1,881	2,862	1,149	1,936	2,990	2,950	2,954	174
	% S Range*	-	65-87	51-97	83-87	70-92	73-100	40-80	78-100	57-97	73-98	47-78
	# Facilities	1	3	6	2	6	5	3	6	5	5	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Enterobacter cloacae

Enterobacter cloacae infections have the highest mortality rate compared to other *Enterobacter* infections. *Enterobacter cloacae* can harbor a variety of multi-class antibiotic resistance genes. In Virginia, greater than 90% of *Enterobacter cloacae* isolates remain susceptible to antibiotics commonly tested, with the exception of piperacillin/tazobactam and aztreonam.

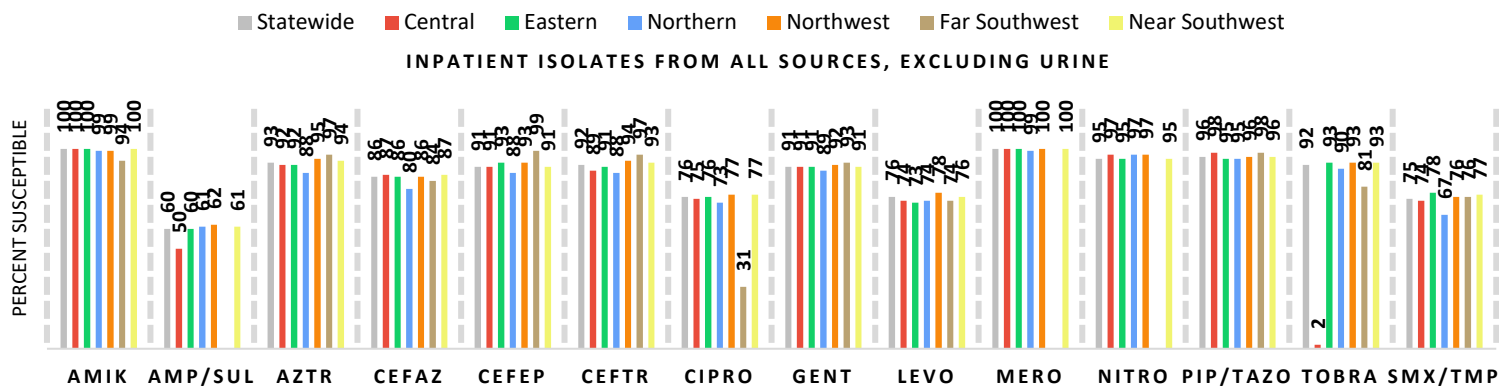


Inpatient isolates from all sources		Amik	Aztr	Cefep	Cipro	Gent	Levo	Mero	Pip/ tazo	Tobra	SMX/ TMP
Statewide	% S	100%	87%	90%	93%	98%	95%	99%	81%	97%	90%
	# Isolates	810	793	2,019	2,025	1,505	2,190	2,532	2,784	2,060	2,784
	% S Range*	99-100	73-97	78-100	82-98	94-100	79-100	94-100	65-96	85-100	85-99
	# Facilities	8	13	25	22	24	27	27	32	28	32
Central	% S	100%	90%	89%	92%	98%	93%	98%	81%	95%	86%
	# Isolates	74	68	335	313	381	381	381	381	154	381
	% S Range*	100	89-91	85-97	82-93	94-100	79-97	97-100	65-94	85-100	85-89
	# Facilities	3	2	5	4	6	6	6	6	5	6
Eastern	% S	100%	81%	98%	98%	98%	96%	99%	83%	98%	93%
	# Isolates	78	256	354	171	454	523	510	597	597	597
	% S Range*	100	73-85	93-100	97-98	97-99	94-98	97-100	71-91	97-100	86-99
	# Facilities	2	6	9	6	8	10	9	12	12	12
Northern	% S	-	97%	81%	94%	97%	94%	98%	83%	96%	92%
	# Isolates	-	233	343	397	334	280	429	429	69	429
	% S Range*	-	-	78-84	93-96	96-97	88-95	94-100	72-90	96	87-93
	# Facilities	-	1	3	4	4	3	5	5	2	5
Northwest	% S	99%	83%	96%	97%	99%	96%	99%	80%	98%	94%
	# Isolates	77	96	201	201	124	220	276	297	297	297
	% S Range*	-	-	91-98	95-98	99	95-98	97-100	68-89	96-99	92-96
	# Facilities	1	1	4	4	3	4	4	5	5	5
Far Southwest	% S	100%	91%	99%	43%	98%	97%	-	96%	71%	89%
	# Isolates	7	79	151	7	151	151	-	144	7	144
	% S Range*	-	97	100	-	99	100	-	-	-	-
	# Facilities	1	2	2	1	2	2	-	1	1	1
Near Southwest	% S	100%	78%	88%	92%	98%	95%	100%	77%	96%	87%
	# Isolates	574	61	635	936	61	635	936	936	936	936
	% S Range*	-	-	88-93	90-97	-	95-97	100	73-87	95-98	85-92
	# Facilities	1	1	2	3	1	2	3	3	3	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Escherichia coli

E. coli are bacteria found in the environment, foods, and intestines of people and animals. *E. coli* is a common cause of urinary tract infections. In Virginia, ampicillin/sulbactam, levofloxacin, ciprofloxacin, and sulfamethoxazole/trimethoprim have reduced susceptibilities compared to other antibiotics commonly tested.



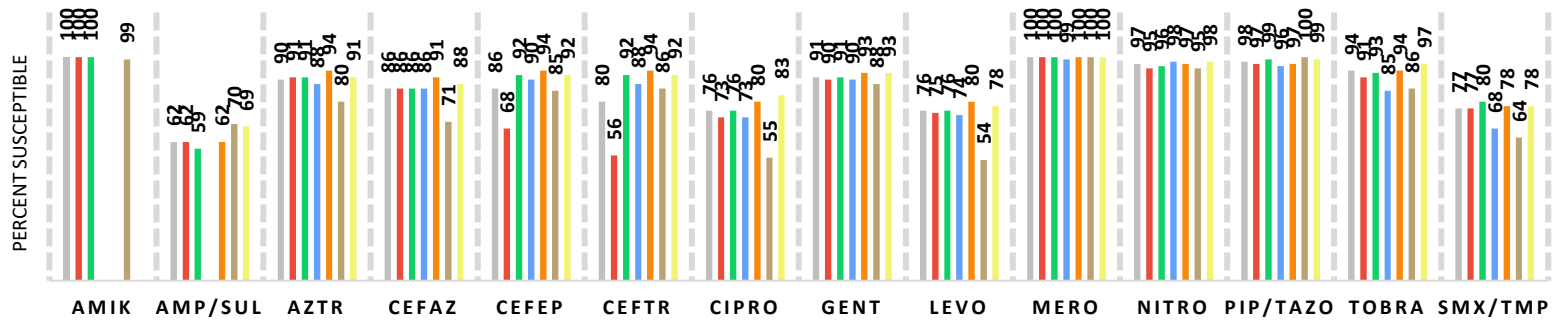
Inpatient isolates from all sources (excluding urine)		Amik	Amp/Sul	Aztr	Cefaz	Cefep	Ceftr	Cipro	Gent	Levo	Mero	Nitro	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	100%	60%	93%	86%	91%	92%	76%	91%	76%	100%	95%	96%	92%	75%
	# Isolates	31,248	48,283	27,048	50,579	12,561	52,417	51,193	52,694	39,577	44,321	35,780	43,434	44,527	31,544
	% S Range*	94-100	40-81	74-98	54-92	40-100	30-100	31-83	86-97	32-85	99-100	93-100	91-100	81-100	52-89
	# Facilities	23	41	31	42	24	47	43	48	34	34	20	40	40	43
Central	% S	100%	50%	92%	87%	91%	90%	75%	91%	74%	100%	97%	98%	92%	74%
	# Isolates	1,504	5,162	1,075	4,303	3,820	5,310	5,089	5,310	4,340	4,642	3,658	4,192	2,082	5,310
	% S Range*	100	40-65	90-94	83-92	40-99	30-94	67-81	87-93	68-78	100	96-97	95-98	89-93	67-80
	# Facilities	6	9	4	7	7	10	8	10	8	8	3	7	7	10
Eastern	% S	100%	60%	92%	86%	93%	91%	76%	91%	73%	100%	95%	95%	93%	78%
	# Isolates	5,478	6,042	5,478	5,920	559	5,792	6,069	6,069	2,220	4,411	3,116	5,141	6,069	6,069
	% S Range*	99-100	49-66	90-97	80-90	90-99	85-97	58-81	86-95	58-80	100	94-97	94-100	89-96	72-89
	# Facilities	11	13	11	13	5	13	14	14	8	10	6	12	14	14
Northern	% S	99%	61%	88%	80%	88%	88%	73%	89%	74%	99%	97%	95%	90%	67%
	# Isolates	4,281	3,684	5,964	5,468	4,352	6,427	6,427	6,427	6,427	5,378	1,097	6,427	3,236	5,378
	% S Range*	99-100	54-81	82-98	75-86	86-91	82-98	64-81	87-92	64-81	99-100	95-98	94-97	87-92	63-70
	# Facilities	3	5	5	5	3	7	7	7	7	5	2	7	5	5
Northwest	% S	99%	62%	95%	86%	93%	94%	77%	92%	78%	100%	97%	96%	93%	76%
	# Isolates	387	4,169	3,631	4,427	538	4,427	4,427	4,427	3,772	699	633	4,427	4,169	4,169
	% S Range*	-	56-69	88-96	62-91	93-98	85-95	72-83	88-93	78-83	100	96-98	91-100	89-94	75-83
	# Facilities	1	5	2	6	3	6	6	6	4	3	2	6	5	5
Far Southwest	% S	94%	-	97%	84%	99%	97%	31%	93%	74%	-	-	98%	81%	76%
	# Isolates	62	-	1,235	1,235	1,235	1,235	62	1,235	1,235	-	-	1,173	62	1,235
	% S Range*	-	-	74-98	54-86	77-100	76-98	-	90-93	32-76	-	-	-	-	52-77
	# Facilities	1	-	2	2	2	2	1	2	2	-	-	1	1	2
Near Southwest	% S	100%	61%	94%	87%	91%	93%	77%	91%	76%	100%	95%	96%	93%	77%
	# Isolates	19,526	29,226	9,665	29,226	2,057	29,226	29,116	29,226	21,583	29,191	27,276	22,074	28,909	9,383
	% S Range*	-	58-66	87-95	81-92	87-100	87-100	56-82	91-97	60-85	100	93-100	91-100	91-100	69-78
	# Facilities	1	9	7	9	4	9	7	9	5	8	7	7	8	7

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Escherichia coli, continued

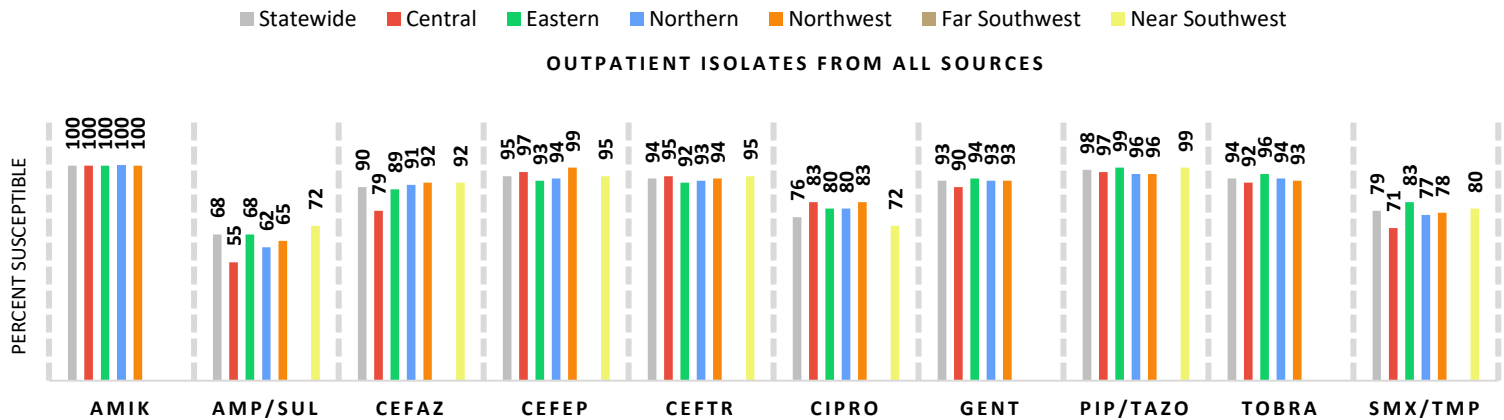
Statewide Central Eastern Northern Northwest Far Southwest Near Southwest

INPATIENT ISOLATES FROM URINE SOURCE



Inpatient isolates from urine source		Amik	Amp/Sul	Aztr	Cefaz	Cefep	Ceftr	Cipro	Gent	Levo	Mero	Nitro	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	100%	62%	90%	86%	86%	80%	76%	91%	76%	100%	97%	98%	94%	77%
	# Isolates	5,957	11,614	6,080	13,821	13,821	9,438	13,127	13,821	13,821	11,114	13,450	11,845	11,217	13,821
	% S Range*	99-100	53-74	68-96	67-93	38-100	22-96	49-84	86-95	50-84	99-100	91-99	94-100	85-100	60-82
	# Facilities	7	15	13	22	22	19	20	22	22	18	21	20	18	22
Central	% S	100%	62%	91%	86%	68%	56%	73%	90%	75%	100%	95%	97%	91%	77%
	# Isolates	740	2,631	670	3,362	3,362	3,063	2,668	3,362	3,362	1,063	2,991	1,794	1,495	3,362
	% S Range*	100	56-63	87-94	79-90	38-100	22-94	71-74	89-93	71-80	100	91-97	94-98	89-93	67-80
	# Facilities	3	5	2	7	7	6	5	7	7	4	6	6	5	7
Eastern	% S	100%	59%	91%	86%	92%	92%	76%	91%	76%	100%	96%	99%	93%	80%
	# Isolates	4,809	5,036	3,198	5,036	5,036	1,360	5,036	5,036	5,036	5,036	5,036	5,036	5,036	5,036
	% S Range*	99-100	53-63	90-94	85-89	91-94	91-94	75-80	90-93	75-80	100	96-99	99-100	90-94	78-80
	# Facilities	3	4	4	4	4	3	4	4	4	4	4	4	4	4
Northern	% S	-	-	88%	86%	90%	88%	73%	90%	74%	99%	98%	96%	85%	68%
	# Isolates	-	-	593	750	750	750	750	750	750	750	750	750	157	750
	% S Range*	-	-	-	85-88	89-95	88-89	64-75	87-91	64-77	99-100	95-99	95-96	-	68-69
	# Facilities	-	-	1	2	2	2	2	2	2	2	2	2	1	2
Northwest	% S	-	62%	94%	91%	94%	94%	80%	93%	80%	100%	97%	97%	94%	78%
	# Isolates	-	1,685	189	1,874	1,874	1,874	1,874	1,874	1,874	1,874	1,874	1,874	1,874	1,874
	% S Range*	-	62-65	-	91-93	94-97	93-96	80-84	92-93	77-84	100	96-98	96-99	94-98	78-80
	# Facilities	-	2	1	3	3	3	3	3	3	3	3	3	3	3
Far Southwest	% S	99%	70%	80%	71%	85%	86%	55%	88%	54%	100%	95%	100%	86%	64%
	# Isolates	408	144	552	552	552	144	552	552	552	144	552	144	408	552
	% S Range*	-	-	68-84	67-83	85-86	-	49-73	86-95	50-67	-	93-96	-	-	60-75
	# Facilities	1	1	2	2	2	1	2	2	2	1	2	1	1	2
Near Southwest	% S	-	69%	91%	88%	92%	92%	83%	93%	78%	100%	98%	99%	97%	78%
	# Isolates	-	2,118	878	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247
	% S Range*	-	67-74	86-96	87-93	91-97	91-96	81-84	93-95	77-80	100	97-99	99-100	97-100	77-82
	# Facilities	-	3	3	4	4	4	4	4	4	4	4	4	4	4

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

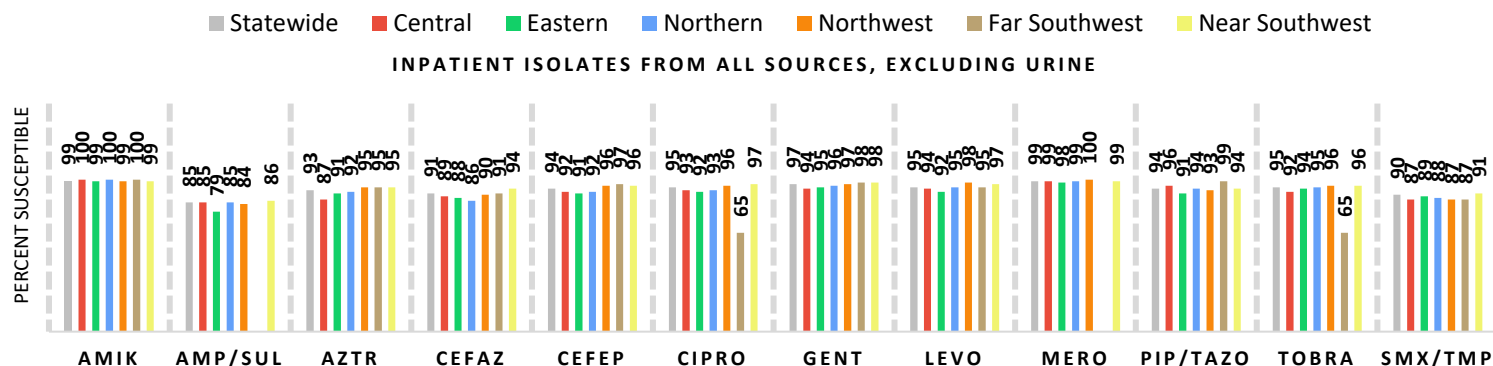
***Escherichia coli*, continued**

Outpatient isolates from all sources		Amik	Amp/Sul	Cefaz	Cefep	Ceftr	Cipro	Gent	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	100%	68%	90%	95%	94%	76%	93%	98%	94%	79%
	# Isolates	6,517	18,622	17,739	18,622	18,622	18,287	8,174	18,622	7,216	18,622
	% S Range*	99-100	50-72	39-94	88-99	88-96	52-86	88-94	95-100	89-96	70-83
	# Facilities	6	10	9	10	10	9	9	10	7	10
Central	% S	100%	55%	79%	97%	95%	83%	90%	97%	92%	71%
	# Isolates	1,316	1,316	1,316	1,316	1,316	981	1,316	1,316	1,316	1,316
	% S Range*	100	50-58	39-94	96-98	92-96	76-86	89-91	96-97	89-93	70-72
	# Facilities	3	3	3	3	3	2	3	3	3	3
Eastern	% S	100%	68%	89%	93%	92%	80%	94%	99%	96%	83%
	# Isolates	2,222	2,297	2,297	2,297	2,297	2,297	2,297	2,297	2,222	2,297
	% S Range*	-	63-68	85-89	91-93	89-92	71-81	92-94	99-100	-	80-83
	# Facilities	1	2	2	2	2	2	2	2	1	2
Northern	% S	100%	62%	91%	94%	93%	80%	93%	96%	94%	77%
	# Isolates	104	1,686	803	1,686	1,686	1,686	1,686	1,686	803	1,686
	% S Range*	-	55-65	88-91	94-96	91-94	79-81	88-93	95-97	91-94	75-78
	# Facilities	1	3	2	3	3	3	3	3	2	3
Northwest	% S	100%	65%	92%	99%	94%	83%	93%	96%	93%	78%
	# Isolates	2,875	2,875	2,875	2,875	2,875	2,875	2,875	2,875	2,875	2,875
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	1	1	1	1	1	1	1	1	1
Far Southwest	% S	-	-	-	-	-	-	-	-	-	-
	# Isolates	-	-	-	-	-	-	-	-	-	-
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	-	-	-	-	-	-	-	-	-	-
Near Southwest	% S	-	72%	92%	95%	95%	72%	-	99%	-	80%
	# Isolates	-	10,448	10,448	10,448	10,448	10,448	-	10,448	-	10,448
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	-	1	1	1	1	1	-	1	-	1

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

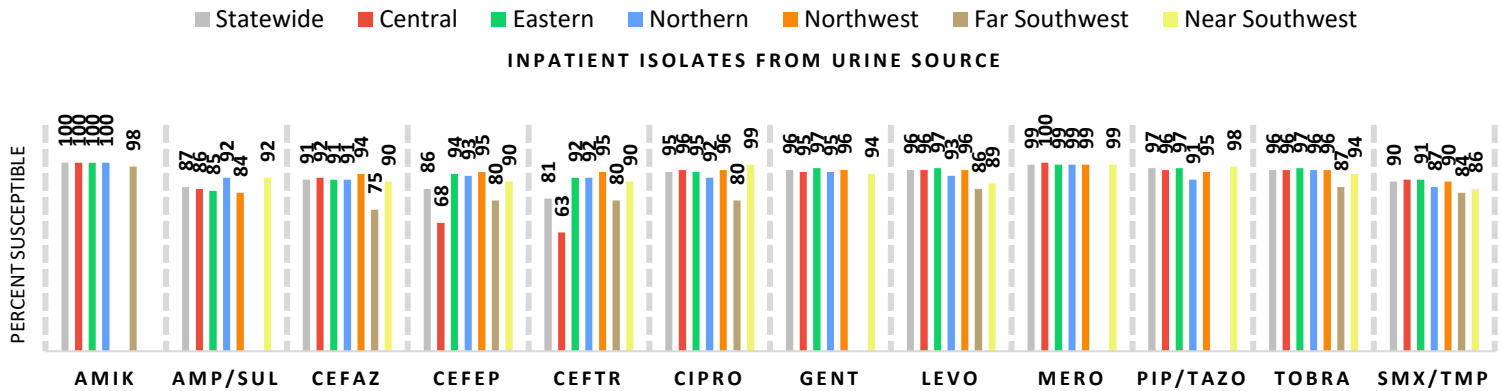
Klebsiella pneumoniae

Klebsiella is a type of bacteria that can cause different types of healthcare-associated infections, including pneumonia, bloodstream infections, and urinary tract infections. Increasingly, *Klebsiella* bacteria have developed antimicrobial resistance, most recently to carbapenems. In Virginia, no facility reported more than 5% resistance to meropenem.



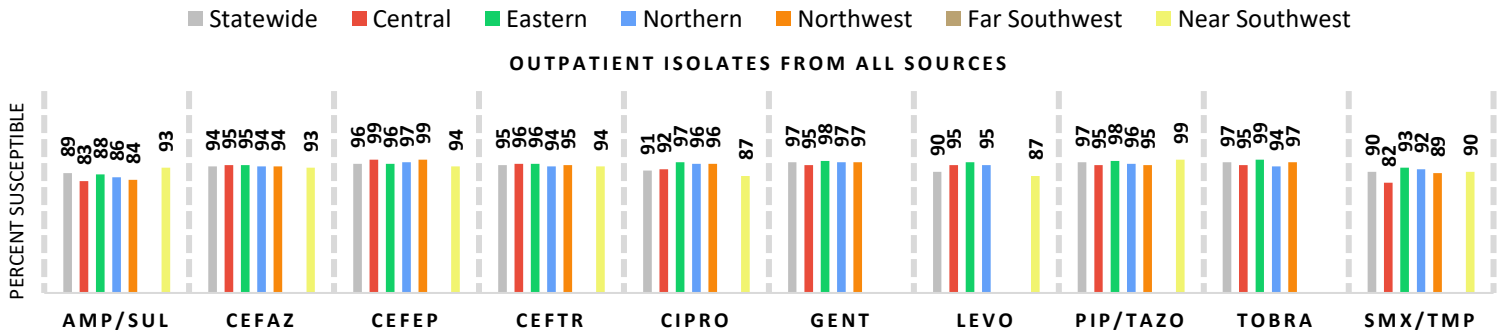
Inpatient isolates from all sources (excluding urine)		Amik	Amp/sul	Aztr	Cefaz	Cefep	Cipro	Gent	Levo	Mero	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	99%	85%	93%	91%	94%	95%	97%	95%	99%	94%	95%	90%
	# Isolates	8,207	12,209	7,228	13,734	12,128	13,911	14,518	11,833	13,637	13,558	12,301	13,977
	% S Range*	98-100	74-96	76-99	74-100	50-100	87-100	78-100	86-100	95-100	84-100	78-100	75-99
	# Facilities	20	35	29	39	39	40	44	37	36	41	34	43
Central	% S	100%	85%	87%	89%	92%	93%	94%	94%	99%	96%	92%	87%
	# Isolates	618	763	439	1,464	1,643	1,668	1,788	1,643	1,730	1,730	763	1,788
	% S Range*	100	78-90	76-96	74-97	50-99	89-100	78-98	91-100	97-100	91-100	78-99	75-96
	# Facilities	6	7	4	7	9	8	10	9	9	9	7	10
Eastern	% S	99%	79%	91%	88%	91%	92%	95%	92%	98%	91%	94%	89%
	# Isolates	1,769	2,017	1,779	2,017	2,017	2,017	2,017	2,017	1,779	2,017	2,355	2,355
	% S Range*	98-100	74-90	88-95	78-100	86-100	87-97	88-100	86-98	95-100	84-100	88-100	82-97
	# Facilities	9	13	10	13	13	13	13	13	10	13	13	13
Northern	% S	100%	85%	92%	86%	92%	93%	96%	95%	99%	94%	95%	88%
	# Isolates	435	856	1,403	1,313	1,545	1,545	1,545	1,545	1,470	1,545	675	1,545
	% S Range*	100	79-94	90-99	83-99	90-100	89-99	93-100	91-99	99-100	91-99	92-100	85-99
	# Facilities	2	5	5	5	7	7	7	7	6	7	4	7
Northwest	% S	99%	84%	95%	90%	96%	96%	97%	98%	100%	93%	96%	87%
	# Isolates	210	1,011	946	1,096	1,096	1,096	1,096	801	1,096	445	1,011	445
	% S Range*	-	74-87	89-97	76-95	92-97	93-97	95-98	97-98	99-100	91-95	93-97	84-93
	# Facilities	1	4	3	5	5	5	5	3	5	4	4	4
Far Southwest	% S	100%	-	95%	91%	97%	65%	98%	95%	-	99%	65%	87%
	# Isolates	23	-	251	251	251	23	479	251	-	228	23	251
	% S Range*	-	-	98	94	100	-	99	97	-	99	65	90
	# Facilities	1	-	2	2	2	1	2	2	-	1	1	2
Near Southwest	% S	99%	86%	95%	94%	96%	97%	98%	97%	99%	94%	96%	91%
	# Isolates	5,152	7,562	2,410	7,593	5,576	7,562	7,593	5,576	7,562	7,593	7,474	7,593
	% S Range*	-	83-96	92-99	91-99	92-97	91-100	95-100	93-97	99-100	93-100	94-100	89-96
	# Facilities	1	6	5	7	3	6	7	3	6	7	5	7

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

***Klebsiella pneumoniae*, continued**

Inpatient isolates from urine source		Amik	Amp/sul	Cefaz	Cefep	Ceftr	Cipro	Gent	Levo	Mero	Pip/tazo	Tobra	SMX/TMP
Statewide	% S	100%	87%	91%	86%	81%	95%	96%	96%	99%	97%	96%	90%
	# Isolates	1,786	2,623	3,261	3,317	2,219	2,679	3,262	2,960	2,596	2,862	2,725	3,317
	% S Range*	98-100	78-94	75-97	25-98	25-97	80-100	86-100	80-100	99-100	88-100	87-100	84-97
	# Facilities	10	15	18	19	17	15	18	18	13	16	16	19
Central	% S	100%	86%	92%	68%	63%	96%	95%	96%	100%	96%	96%	91%
	# Isolates	499	973	973	973	869	722	973	973	396	603	487	973
	% S Range*	100	78-88	81-96	25-97	25-95	96	86-99	94-98	100	89-100	95-99	87-97
	# Facilities	5	7	7	7	6	5	7	7	4	6	5	7
Eastern	% S	100%	85%	91%	94%	92%	95%	97%	97%	99%	97%	97%	91%
	# Isolates	1,183	633	1,183	1,183	189	1,183	1,183	1,183	1,183	1,183	1,183	1,183
	% S Range*	100	85	90-94	93-98	91-96	95-100	97-100	97-100	99-100	97-98	96-100	90-92
	# Facilities	3	2	3	3	2	3	3	3	3	3	3	3
Northern	% S	100%	92%	91%	93%	92%	92%	95%	93%	99%	91%	96%	87%
	# Isolates	49	155	155	155	155	155	155	155	155	155	49	155
	% S Range*	100	92	88-96	90-98	90-96	92	95-96	92-94	99-100	88-96	96	86-90
	# Facilities	1	2	2	2	2	2	2	2	2	2	1	2
Northwest	% S	-	84%	94%	95%	95%	96%	96%	96%	99%	95%	96%	90%
	# Isolates	-	395	369	425	425	395	425	425	395	395	425	425
	% S Range*	-	84	94-97	95-97	95-97	96	95-97	96-100	99-100	95	95-97	90-91
	# Facilities	-	2	2	3	3	2	3	3	2	2	3	3
Far Southwest	% S	98%	-	75%	80%	80%	80%	-	86%	-	-	87%	84%
	# Isolates	55	-	55	55	55	55	-	55	-	-	55	55
	% S Range*	-	-	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	-	1	1	1	1	-	1	-	-	1	1
Near Southwest	% S	-	92%	90%	90%	90%	99%	94%	89%	99%	98%	94%	86%
	# Isolates	-	467	526	526	526	169	526	169	467	526	526	526
	% S Range*	-	91-94	88-95	88-97	88-97	98-100	93-98	80-94	99-100	98-100	92-100	84-93
	# Facilities	-	2	3	3	3	2	3	2	2	3	3	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

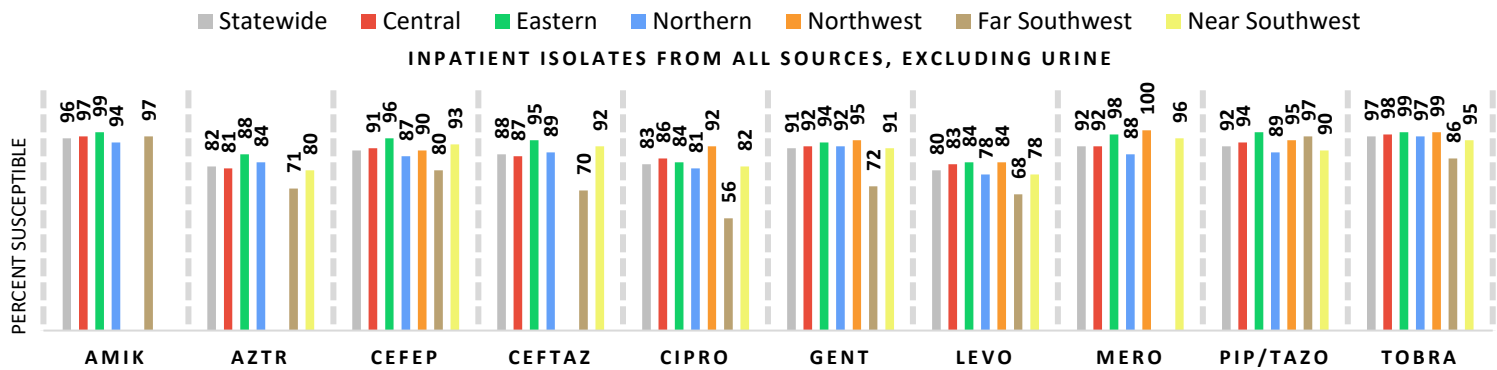
***Klebsiella pneumoniae*, continued**

Outpatient isolates from all sources		Amp/ sul	Cefaz	Cefep	Ceftr	Cipro	Gent	Levo	Pip/ tazo	Tobra	SMX/ TMP
Statewide	% S	89%	94%	96%	95%	91%	97%	90%	97%	97%	90%
	# Isolates	3,977	4,027	3,986	4,027	3,972	1,944	3,038	4,006	1,749	4,027
	% S Range*	71-94	73-100	75-100	75-100	76-98	90-100	76-100	91-99	91-100	71-96
	# Facilities	9	10	9	10	9	9	8	9	8	10
Central	% S	83%	95%	99%	96%	92%	95%	95%	95%	95%	82%
	# Isolates	263	313	313	313	258	313	209	313	313	313
	% S Range*	82-85	93-100	98-100	94-100	86-98	90-100	93-100	91-98	93-100	71-94
	# Facilities	2	3	3	3	2	3	3	3	3	3
Eastern	% S	88%	95%	96%	96%	97%	98%	97%	98%	99%	93%
	# Isolates	497	497	497	497	497	497	497	476	497	497
	% S Range*	88	95	96	96	97	98	98	-	99	93
	# Facilities	2	2	2	2	2	2	2	1	2	2
Northern	% S	86%	94%	97%	94%	96%	97%	95%	96%	94%	92%
	# Isolates	444	444	403	444	444	444	249	444	249	444
	% S Range*	81-88	87-97	96-98	87-97	91-98	92-99	94-96	95-98	91-97	85-96
	# Facilities	3	3	2	3	3	3	2	3	2	3
Northwest	% S	84%	94%	99%	95%	96%	97%	-	95%	97%	89%
	# Isolates	690	690	690	690	690	690	-	690	690	690
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	1	1	1	1	1	-	1	1	1
Far Southwest	% S	-	-	-	-	-	-	-	-	-	-
	# Isolates	-	-	-	-	-	-	-	-	-	-
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	-	-	-	-	-	-	-	-	-	-
Near Southwest	% S	93%	93%	94%	94%	87%	-	87%	99%	-	90%
	# Isolates	2,083	2,083	2,083	2,083	2,083	-	2,083	2,083	-	2,083
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	1	1	1	1	-	1	1	-	1

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

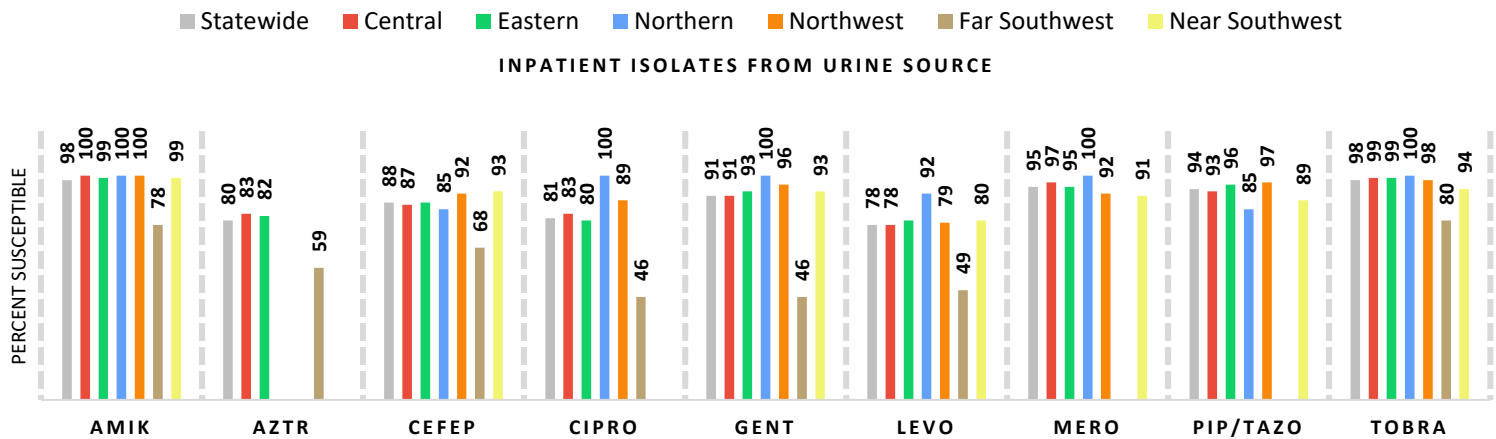
Pseudomonas aeruginosa

Pseudomonas aeruginosa can cause infections in the blood, lungs, or other parts of the body after surgery. In 2017, multidrug-resistant *Pseudomonas aeruginosa* caused an estimated 32,600 infections among hospitalized patients and 2,700 estimated deaths in the United States. In Virginia, anti-pseudomonal beta-lactams provide better empiric coverage compared to fluoroquinolones.



Inpatient isolates from all sources (excluding urine)		Amik	Aztr	Cefep	Ceftaz	Cipro	Gent	Levo	Mero	Pip/tazo	Tobra
Statewide	% S	96%	82%	90%	88%	83%	91%	80%	92%	92%	97%
	# Isolates	1,278	1,681	3,129	1,225	2,858	3,129	3,129	2,443	3,058	2,411
	% S Range*	94-100	61-100	68-100	70-100	56-93	70-98	59-100	85-99	87-100	86-100
	# Facilities	11	12	23	10	19	23	23	15	22	20
Central	% S	97%	81%	91%	87%	86%	92%	83%	92%	94%	98%
	# Isolates	346	235	955	169	826	955	955	869	955	346
	% S Range*	95-100	76-86	84-99	83-93	80-93	84-95	71-90	90-99	92-100	93-100
	# Facilities	5	3	7	3	5	7	7	6	7	5
Eastern	% S	99%	88%	96%	95%	84%	94%	84%	98%	99%	99%
	# Isolates	245	245	290	63	290	290	290	245	290	290
	% S Range*	99-100	87-92	93-96	93	73-89	92-98	71-89	97-98	98-100	98-100
	# Facilities	4	4	5	2	5	5	5	4	5	5
Northern	% S	94%	84%	87%	89%	81%	92%	78%	88%	89%	97%
	# Isolates	616	839	930	707	930	930	930	839	930	930
	% S Range*	-	78-100	85-95	88-93	80-91	91-95	75-87	85-96	88-93	96-99
	# Facilities	1	2	3	2	3	3	3	2	3	3
Northwest	% S	-	-	90%	-	92%	95%	84%	100%	95%	99%
	# Isolates	-	-	267	-	267	267	267	16	267	267
	% S Range*	-	-	90	-	90-92	94-95	84	-	93-100	99
	# Facilities	-	-	3	-	3	3	3	1	3	3
Far Southwest	% S	97%	71%	80%	70%	56%	72%	68%	-	97%	86%
	# Isolates	71	180	180	71	71	180	180	-	109	71
	% S Range*	-	61-78	68-88	-	-	70-74	59-74	-	-	-
	# Facilities	1	2	2	1	1	2	2	-	1	1
Near Southwest	% S	-	80%	93%	92%	82%	91%	78%	96%	90%	95%
	# Isolates	-	182	507	215	474	507	507	474	507	507
	% S Range*	-	80	92-100	91-100	80-85	87-97	72-100	96-97	87-100	93-99
	# Facilities	-	1	3	2	2	3	3	2	3	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

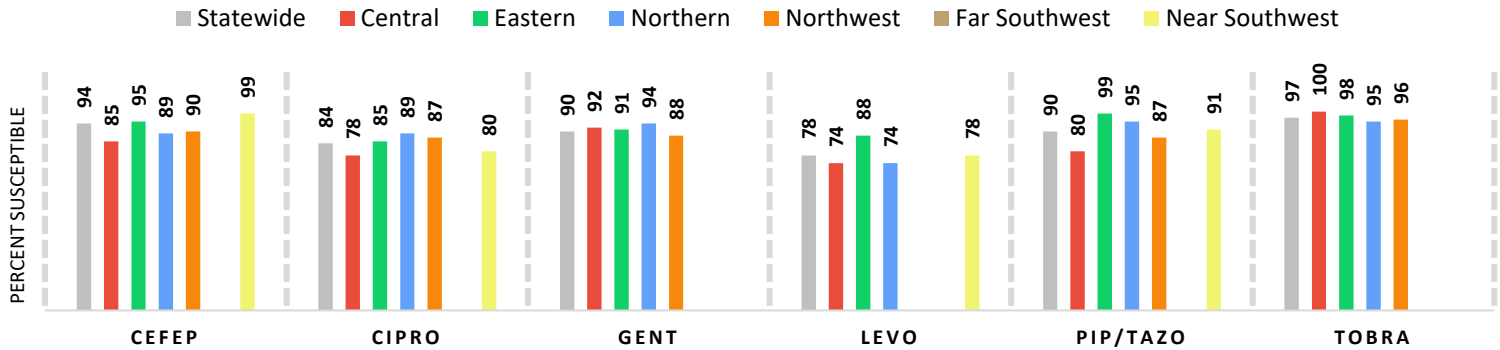
Pseudomonas aeruginosa, continued

Inpatient isolates from urine source		Amik	Aztr	Cefep	Cipro	Gent	Levo	Mero	Pip/ tazo	Tobra
Statewide	% S	98%	80%	88%	81%	91%	78%	95%	94%	98%
	# Isolates	830	469	1,129	951	1,208	1,208	955	1,198	1,184
	% S Range*	78-100	59-85	68-100	46-94	46-96	49-94	91-100	76-100	80-100
	# Facilities	11	7	16	13	16	16	11	16	16
Central	% S	100%	83%	87%	83%	91%	78%	97%	93%	99%
	# Isolates	126	120	264	257	374	374	180	374	319
	% S Range*	100	80-85	70-92	80-85	83-95	69-83	95-100	76-100	96-100
	# Facilities	3	2	6	5	7	7	4	7	6
Eastern	% S	99%	82%	88%	80%	93%	80%	95%	96%	99%
	# Isolates	341	308	499	499	499	499	499	499	499
	% S Range*	98-100	81-85	87-97	78-94	87-94	78-94	95-100	96-97	99-100
	# Facilities	4	4	4	4	4	4	4	4	4
Northern	% S	100%	-	85%	100%	100%	92%	100%	85%	100%
	# Isolates	13	-	13	13	13	13	13	13	13
	% S Range*	-	-	-	-	-	-	-	-	-
	# Facilities	1	-	1	1	1	1	1	1	1
Northwest	% S	100%	-	92%	89%	96%	79%	92%	97%	98%
	# Isolates	110	-	141	141	141	141	123	141	141
	% S Range*	-	-	94	91	96	81	-	98	98
	# Facilities	1	-	2	2	2	2	1	2	2
Far Southwest	% S	78%	59%	68%	46%	46%	49%	-	-	80%
	# Isolates	41	41	41	41	41	41	-	-	41
	% S Range*	-	-	-	-	-	-	-	-	-
	# Facilities	1	1	1	1	1	1	-	-	1
Near Southwest	% S	99%	-	93%	-	93%	80%	91%	89%	94%
	# Isolates	199	-	171	-	140	140	140	171	171
	% S Range*	-	-	92-100	-	-	-	-	87-100	93-100
	# Facilities	1	-	2	-	1	1	1	2	2

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Pseudomonas aeruginosa, continued

OUTPATIENT ISOLATES FROM ALL SOURCES

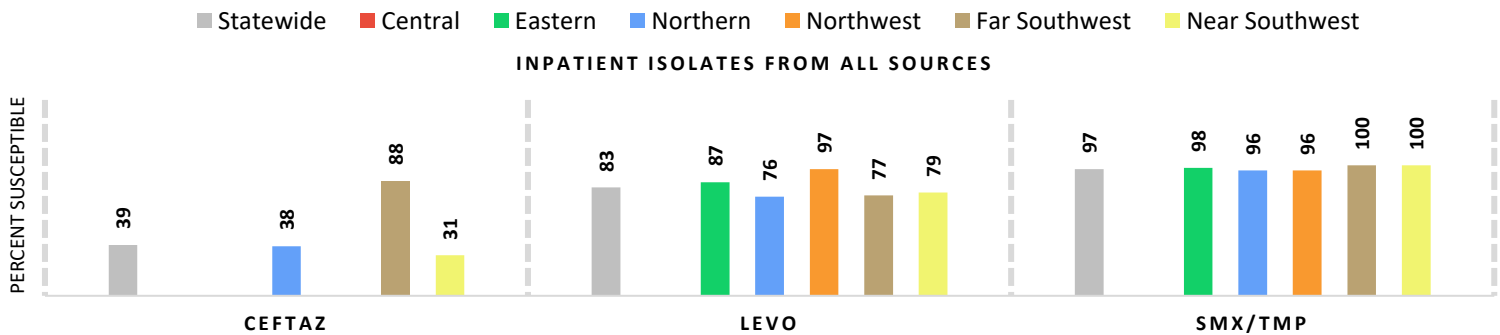


Outpatient isolates from all sources		Cefep	Cipro	Gent	Levo	Pip/ tazo	Tobra
Statewide	% S	94%	84%	90%	78%	90%	97%
	# Isolates	1,618	1,618	928	1,093	1,603	871
	% S Range*	82-100	76-92	88-98	73-87	79-100	92-100
	# Facilities	10	10	9	8	9	8
Central	% S	85%	78%	92%	74%	80%	100%
	# Isolates	92	92	92	92	92	92
	% S Range*	82-86	76-78	91-94	74-76	79-82	100
	# Facilities	3	3	3	3	3	3
Eastern	% S	95%	85%	91%	88%	99%	98%
	# Isolates	134	134	134	134	119	134
	% S Range*	94	86	91	87	-	100
	# Facilities	2	2	2	2	1	2
Northern	% S	89%	89%	94%	74%	95%	95%
	# Isolates	234	234	234	177	234	177
	% S Range*	83-98	83-92	92-98	73-75	90-100	92-100
	# Facilities	3	3	3	2	3	2
Northwest	% S	90%	87%	88%	-	87%	96%
	# Isolates	468	468	468	-	468	468
	% S Range*	-	-	-	-	-	-
	# Facilities	1	1	1	-	1	1
Far Southwest	% S	-	-	-	-	-	-
	# Isolates	-	-	-	-	-	-
	% S Range*	-	-	-	-	-	-
	# Facilities	-	-	-	-	-	-
Near Southwest	% S	99%	80%	-	78%	91%	-
	# Isolates	690	690	-	690	690	-
	% S Range*	-	-	-	-	-	-
	# Facilities	1	1	-	1	1	-

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Stenotrophomonas maltophilia

Stenotrophomonas maltophilia is an opportunistic pathogen found in the environment, particularly in water. *Stenotrophomonas maltophilia* is inherently resistant to multiple antimicrobial agents that are used to treat gram-negative infections. In Virginia, *Stenotrophomonas maltophilia* isolates are more likely to be susceptible to sulfamethoxazole/trimethoprim with some regional variations.

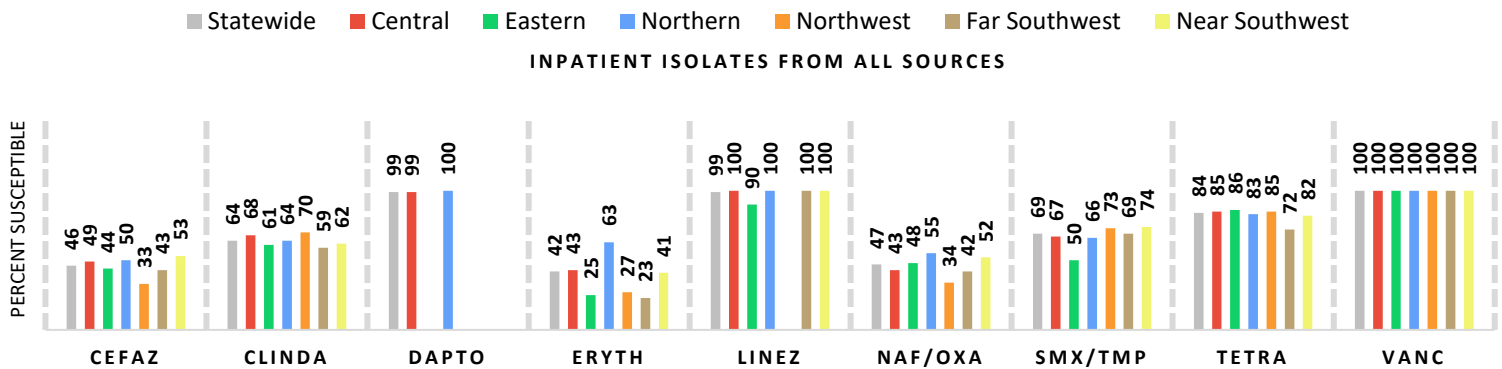


Inpatient isolates from all sources		Ceftaz	Levo	SMX/TMP
Statewide	% S	39%	83%	97%
	# Isolates	184	395	468
	% S Range*	36-44	70-96	92-100
	# Facilities	4	13	15
Central	% S	-	-	-
	# Isolates	-	-	-
	% S Range*	-	-	-
	# Facilities	-	-	-
Eastern	% S	-	87%	98%
	# Isolates	-	130	130
	% S Range*	-	86-91	97-98
	# Facilities	-	5	5
Northern	% S	38%	76%	96%
	# Isolates	146	166	197
	% S Range*	36-44	70-85	94-97
	# Facilities	2	4	5
Northwest	% S	-	97%	96%
	# Isolates	-	61	103
	% S Range*	-	96	92-100
	# Facilities	-	2	3
Far Southwest	% S	88%	77%	100%
	# Isolates	9	9	9
	% S Range*	-	-	-
	# Facilities	1	1	1
Near Southwest	% S	31%	79%	100%
	# Isolates	29	29	29
	% S Range*	-	-	-
	# Facilities	1	1	1

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Coagulase-negative *Staphylococci*

Most of the coagulase-negative *Staphylococci* associated with clinical disease are common inhabitants of the skin and mucous membranes. This group of organisms has been implicated in catheter related infections, osteomyelitis and endocarditis. In Virginia, resistance to cefazolin, nafcillin, and oxacillin is common but varies greatly by facility.

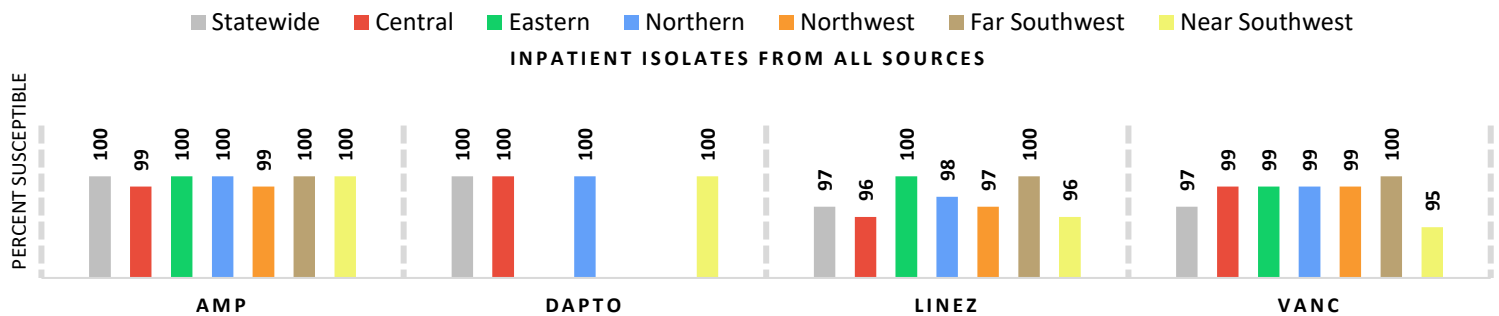


Inpatient isolates from all sources		Cefaz	Clinda	Dapto	Eryth	Linez	Naf/Oxa	SMX/TMP	Tetra	Vanc
Statewide	% S	46%	64%	99%	42%	99%	47%	69%	84%	100%
	# Isolates	2,109	2,403	493	1,283	1,138	3,199	1,911	2,556	3,072
	% S Range*	11-71	56-73	99-100	15-63	88-100	22-93	54-98	70-93	100
	# Facilities	18	20	4	12	11	25	15	23	24
Central	% S	49%	68%	99%	43%	100%	43%	67%	85%	100%
	# Isolates	388	577	388	877	447	1,165	1,165	673	1,038
	% S Range*	40-62	64-73	99-100	27-54	100	22-62	54-98	81-92	100
	# Facilities	3	4	3	5	4	7	7	6	6
Eastern	% S	44%	61%	-	25%	90%	48%	50%	86%	100%
	# Isolates	1,053	1,053	-	16	123	1,053	16	1,053	1,053
	% S Range*	11-63	56-67	-	-	88	42-63	-	83-88	100
	# Facilities	8	8	-	1	2	8	1	8	8
Northern	% S	50%	64%	100%	63%	100%	55%	66%	83%	100%
	# Isolates	135	240	105	57	105	297	105	297	297
	% S Range*	-	64	-	63	-	41-93	-	78-93	100
	# Facilities	1	2	1	1	1	3	1	3	3
Northwest	% S	33%	70%	-	27%	-	34%	73%	85%	100%
	# Isolates	70	70	-	11	-	70	11	70	70
	% S Range*	32	71	-	-	-	34	-	85	100
	# Facilities	2	2	-	1	-	2	1	2	2
Far Southwest	% S	43%	59%	-	23%	100%	42%	69%	72%	100%
	# Isolates	83	83	-	83	83	83	83	83	83
	% S Range*	41-44	57-62	-	15-31	100	41-43	67-70	70-74	100
	# Facilities	2	2	-	2	2	2	2	2	2
Near Southwest	% S	53%	62%	-	41%	100%	52%	74%	82%	100%
	# Isolates	380	380	-	239	380	531	531	380	531
	% S Range*	47-71	60-70	-	37-49	100	47-70	68-80	82	100
	# Facilities	2	2	-	2	2	3	3	2	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Enterococcus faecalis

Enterococci have emerged as a major cause of healthcare-associated infections, and within this group *Enterococcus faecalis* causes the majority of infections. In Virginia, *Enterococcus faecalis* isolates remain highly susceptible to common antibiotics tested including ampicillin, the drug of choice for treating infections caused by *Enterococcus faecalis*.

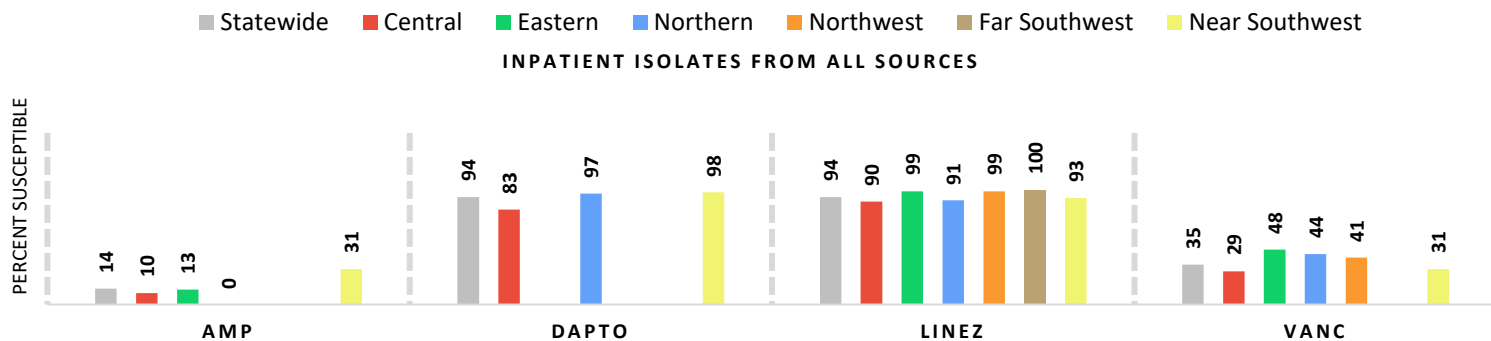


Inpatient isolates from all sources		Amp	Dapto	Linez	Vanc
Statewide	% S	100%	100%	97%	97%
	# Isolates	6,299	5,341	8,010	10,907
	% S Range*	98-100	98-100	90-100	95-100
	# Facilities	37	7	29	41
Central	% S	99%	100%	96%	99%
	# Isolates	1,596	245	495	1,613
	% S Range*	99-100	98-100	90-100	98-100
	# Facilities	8	3	6	9
Eastern	% S	100%	-	100%	99%
	# Isolates	1,874	-	1,511	1,874
	% S Range*	99-100	-	99-100	97-100
	# Facilities	13	-	10	13
Northern	% S	100%	100%	98%	99%
	# Isolates	1,123	163	505	1,372
	% S Range*	100	-	96-100	95-100
	# Facilities	6	1	4	7
Northwest	% S	99%	-	97%	99%
	# Isolates	878	-	267	816
	% S Range*	98-100	-	96-100	96-100
	# Facilities	6	-	3	6
Far Southwest	% S	100%	-	100%	100%
	# Isolates	234	-	242	242
	% S Range*	-	-	100	100
	# Facilities	1	-	2	2
Near Southwest	% S	100%	100%	96%	95%
	# Isolates	594	4,933	4,990	4,990
	% S Range*	100	100	95-100	95-97
	# Facilities	3	3	4	4

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Enterococcus faecium

Enterococcus faecium is not as prevalent as *Enterococcus faecalis*, however, *Enterococcus faecium* can be highly drug resistant. In Virginia, *Enterococcus faecium* isolates are commonly resistant to ampicillin and vancomycin. The amount of daptomycin and linezolid resistance is comparatively lower, but still concerning.



Inpatient isolates from all sources		Amp	Dapto	Linez	Vanc
Statewide	% S	14%	94%	94%	35%
	# Isolates	370	235	1,386	1,779
	% S Range*	9-31	9100	84-100	25-100
	# Facilities	5	7	27	31
Central	% S	10%	83%	90%	29%
	# Isolates	287	52	111	385
	% S Range*	9	-	84	25-47
	# Facilities	2	3	6	7
Eastern	% S	13%	-	99%	48%
	# Isolates	8	-	246	283
	% S Range*	-	-	98-100	38-100
	# Facilities	1	-	10	11
Northern	% S	0%	97%	91%	44%
	# Isolates	12	96	124	153
	% S Range*	-	100	91	60
	# Facilities	1	2	4	5
Northwest	% S	-	-	99%	41%
	# Isolates	-	-	98	153
	% S Range*	-	-	99	32-48
	# Facilities	-	-	3	5
Far Southwest	% S	-	-	100%	-
	# Isolates	-	-	2	-
	% S Range*	-	-	-	-
	# Facilities	-	-	1	-
Near Southwest	% S	31%	98%	93%	31%
	# Isolates	63	87	805	805
	% S Range*	-	100	92-100	30-37
	# Facilities	1	2	3	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Staphylococcus aureus

Staphylococcus aureus is the most common cause of staph infections and is responsible for various diseases including skin infections and invasive diseases such as osteomyelitis, bacteremia, endocarditis, and pneumonia. Resistance to antibiotics has become an increasing problem in the previous decade. In Virginia, almost half of the isolates tested are methicillin resistant.

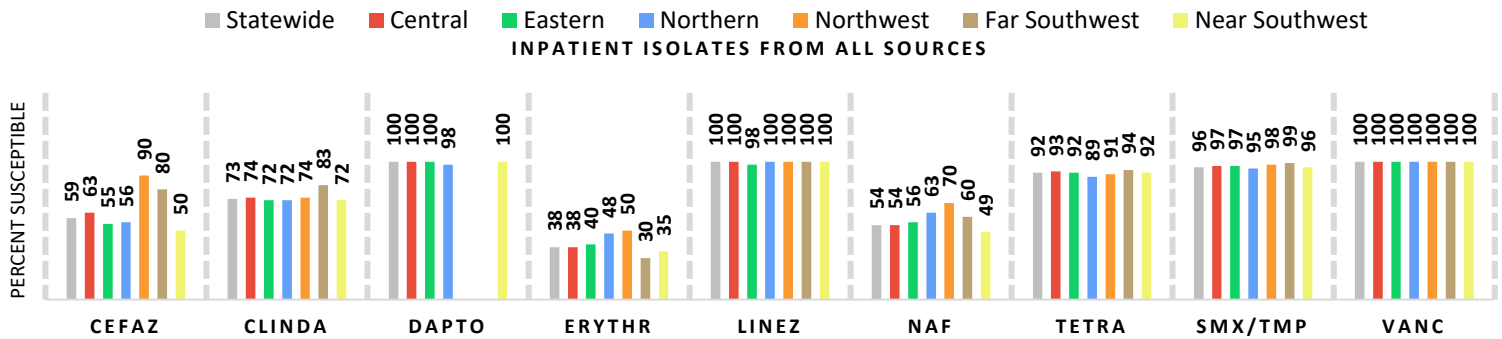


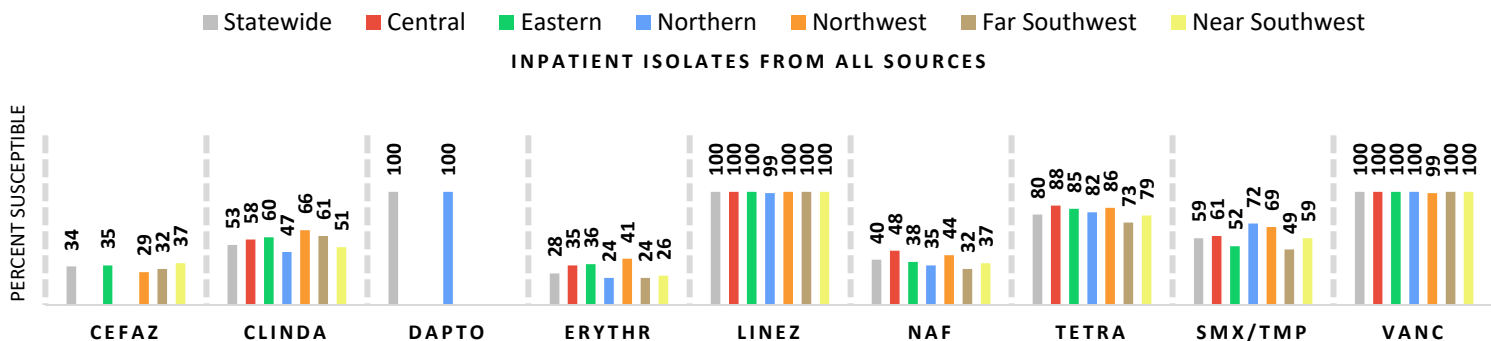
Table 16 *Staphylococcus aureus*

Inpatient isolates from all sources		Cefaz	Clinda	Dapto	Erythr	Linez	Naf/Oxa	Tetra	SMX/TMP	Vanc
Statewide	% S	59%	73%	100%	38%	100%	54%	92%	96%	100%
	# Isolates	6,814	14,759	14,877	23,184	19,010	27,898	29,253	28,896	29,977
	% S Range*	0-100	48-90	88-100	5-70	61-100	0-100	73-100	82-100	100
	# Facilities	23	44	17	34	33	46	49	48	49
Central	% S	63%	74%	100%	38%	100%	54%	93%	97%	100%
	# Isolates	816	2,058	816	4,846	2,213	5,288	5,563	5,563	5,181
	% S Range*	0-100	58-84	99-100	7-66	100	0-100	81-98	82-100	100
	# Facilities	3	7	3	8	7	9	10	10	10
Eastern	% S	55%	72%	100%	40%	98%	56%	92%	97%	100%
	# Isolates	3,166	4,198	1,891	1,884	3,171	4,198	4,198	3,775	4,198
	% S Range*	44-100	57-86	100	5-62	61-100	0-100	83-95	92-100	100
	# Facilities	11	14	6	7	11	14	14	13	14
Northern	% S	56%	72%	98%	48%	100%	63%	89%	95%	100%
	# Isolates	501	2,962	2,474	1,934	2,676	2,962	2,962	2,962	3,002
	% S Range*	-	48-82	88-100	14-70	100	0-100	75-95	92-100	100
	# Facilities	1	7	5	4	5	7	7	7	7
Northwest	% S	90%	74%	-	50%	100%	70%	91%	98%	100%
	# Isolates	691	2,595	-	1,813	636	1,967	2,595	2,595	2,595
	% S Range*	53-100	63-85	-	18-65	100	0-100	73-98	95-100	100
	# Facilities	3	6	-	4	3	5	6	6	6
Far Southwest	% S	80%	83%	-	30%	100%	60%	94%	99%	100%
	# Isolates	244	433	-	433	433	329	433	433	433
	% S Range*	0-100	73-90	-	8-53	100	0-100	91-100	99-100	100
	# Facilities	2	3	-	3	3	2	3	3	3
Near Southwest	% S	50%	72%	100%	35%	100%	49%	92%	96%	100%
	# Isolates	1,396	2,513	9,696	12,274	9,881	13,154	13,502	13,568	13,568
	% S Range*	0-100	56-89	100	13-60	100	0-100	88-100	90-100	100
	# Facilities	3	7	3	8	4	9	9	9	9

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Staphylococcus epidermidis

Staphylococcus epidermidis is one of the most significant coagulase-negative staphylococci. These organisms typically live on the human skin and mucosa and are a common cause of infections associated with catheters and implants. In Virginia, *Staphylococcus epidermidis* isolates are slightly more resistant than other coagulase-negative *Staphylococci*.

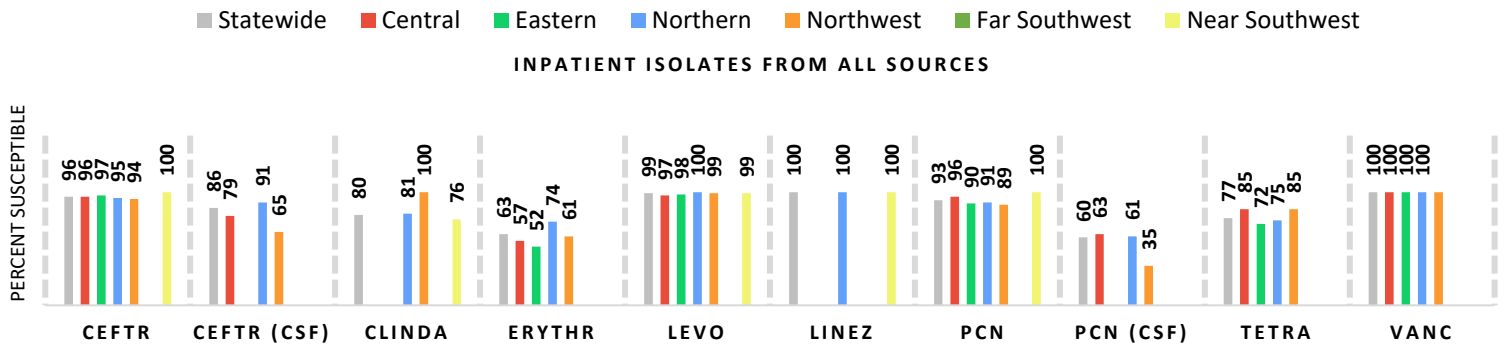


Inpatient isolates from all sources		Cefaz	Clinda	Dapto	Erythr	Linez	Naf	Tetra	SMX/TMP	Vanc
Statewide	% S	34%	53%	100%	28%	100%	40%	80%	59%	100%
	# Isolates	468	4,507	169	4,523	4,353	1,315	4,612	4,385	4,634
	% S Range*	29-42	47-68	100	22-45	98-100	29-49	71-92	45-71	99-100
	# Facilities	6	14	2	16	14	16	17	15	18
Central	% S	-	58%	-	35%	100%	48%	88%	61%	100%
	# Isolates	-	272	-	331	331	280	331	331	331
	% S Range*	-	-	-	35	100	49	88-92	51-64	100
	# Facilities	-	1	-	3	3	2	3	3	3
Eastern	% S	35%	60%	-	36%	100%	38%	85%	52%	100%
	# Isolates	46	209	-	209	163	209	209	129	209
	% S Range*	-	56-62	-	33-37	100	35-39	80-91	46-54	100
	# Facilities	1	4	-	4	3	4	4	3	4
Northern	% S	-	47%	100%	24%	99%	35%	82%	72%	100%
	# Isolates	-	140	169	186	169	208	186	39	208
	% S Range*	-	47	100	24-27	98-99	33-38	80-84		100
	# Facilities	-	2	2	3	2	4	3	2	4
Northwest	% S	29%	66%	-	41%	100%	44%	86%	69%	99%
	# Isolates	59	255	-	255	59	255	255	255	255
	% S Range*	-	59-68	-	29-45	-	29-49	81-88	69-71	99-100
	# Facilities	1	2	-	2	1	2	2	2	2
Far Southwest	% S	32%	61%	-	24%	100%	32%	73%	49%	100%
	# Isolates	185	185	-	185	185	185	185	185	185
	% S Range*	31	59	-	22	100	31	71	45	100
	# Facilities	2	2	-	2	2	2	2	2	2
Near Southwest	% S	37%	51%	-	26%	100%	37%	79%	59%	100%
	# Isolates	178	3,446	-	3,357	3,446	178	3,446	3,446	3,446
	% S Range*	32-42	50-64	-	26-40	100	32-42	79-87	55-70	100
	# Facilities	2	3	-	2	3	2	3	3	3

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Streptococcus pneumoniae

Streptococcus pneumoniae is known to cause pneumonia, bacteremia, otitis media, and meningitis. In Virginia, *Streptococcus pneumoniae* isolates remain highly susceptible to ceftriaxone, levofloxacin, and vancomycin. Resistance is more frequent when cerebrospinal fluid (CSF) breakpoints are applied to ceftriaxone and penicillin.



Inpatient isolates from all sources		Ceftr	Ceftr (CSF)	Clinda	Erythr	Levo	Linez	PCN	PCN (CSF)	Tetra	Vanc
Statewide	% S	96%	86%	80%	63%	99%	100%	93%	60%	77%	100%
	# Isolates	802	328	324	564	774	203	782	307	615	713
	% S Range*	93-100	79-90	76-82	45-95	94-100	100	92-100	61-66	66-83	100
	# Facilities	23	6	5	19	22	2	22	5	19	22
Central	% S	96%	79%	-	57%	97%	-	96%	63%	85%	100%
	# Isolates	158	86	-	118	163	-	177	86	99	223
	% S Range*	94-98	79	-	45	94-100	-	93-98	66	83	100
	# Facilities	4	2	-	4	5	-	5	2	3	5
Eastern	% S	97%	-	-	52%	98%	-	90%	-	72%	100%
	# Isolates	188	-	-	169	188	-	170	-	188	202
	% S Range*	97	-	-	51-66	100	-	94-97	-	66-80	100
	# Facilities	9	-	-	8	9	-	8	-	9	10
Northern	% S	95%	91%	81%	74%	100%	100%	91%	61%	75%	100%
	# Isolates	235	219	219	214	235	99	214	198	235	235
	% S Range*	96	89-90	82	59-95	100	-	92	61	76	100
	# Facilities	4	3	3	3	4	1	3	2	4	4
Northwest	% S	94%	65%	100%	61%	99%	-	89%	35%	85%	100%
	# Isolates	117	23	1	63	84	-	117	23	93	53
	% S Range*	93	-	-	61	98	-	96	-	82	
	# Facilities	5	1	1	4	3	-	5	1	3	3
Far Southwest	% S	-	-	-	-	-	-	-	-	-	-
	# Isolates	-	-	-	-	-	-	-	-	-	-
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	-	-	-	-	-	-	-	-	-	-
Near Southwest	% S	100%	-	76%	-	99%	100%	100%	-	-	-
	# Isolates	104	-	104	-	104	104	104	-	-	-
	% S Range*	-	-	-	-	-	-	-	-	-	-
	# Facilities	1	-	1	-	1	1	1	-	-	-

*Percent susceptible range was only calculated for facilities reporting ≥ 30 isolates and when data were from more than one facility.

Frequently Asked Questions

1. *How do I use an antibiogram?*

When selecting empiric antibiotic therapy, an antibiogram can be used in addition to infection-specific factors and patient-specific factors (e.g., allergies, history of multidrug-resistant organisms, etc.). An antibiogram provides data on local susceptibility of certain organisms, giving the provider an idea of which antibiotic should be susceptible. Resistance varies geographically, so a local antibiogram should be used when making treatment guidelines for a facility. When patient-specific cultures and susceptibilities become available, antibiotics should be streamlined appropriately.

2. *How should a facility prepare an antibiogram?*

Facilities should prepare an antibiogram according to the guidance found in the Clinical & Laboratory Standards Institute (CLSI) M39 document. The current recommendations are to analyze and present data at least annually; include only species with at least 30 isolates tested; include diagnostic, not surveillance, isolates; include results only for drugs that are routinely tested; and include the first isolate per patient in the period analyzed, irrespective of the body site from which the specimen was obtained or the antimicrobial susceptibility pattern.

3. *How should I use the state and regional antibiogram if my facility already has an antibiogram?*

The state and regional antibiogram can be used as an additional source of information to inform empiric treatment decisions. The regional antibiogram is meant to supplement the facility antibiogram, not replace it. The regional antibiogram may include data that the facility does not report.

4. *How should I use the state and regional antibiogram if my facility does not have an antibiogram?*

You can use the state and regional antibiogram to help inform empiric antibiotic therapy and guide treatment recommendations. Data presented in the state and regional antibiogram were submitted from acute care and critical access hospitals across Virginia. Other infection-specific and patient-specific factors (e.g. source of infection, allergies, history of multidrug-resistant organisms, etc.) should be used in conjunction with an antibiogram to develop the best treatment plan.

Before using the state and regional antibiogram you should read the methodology and limitations section located on pages 2-3. Percent susceptibilities determined from a small number of isolates and a low number of facilities should be interpreted with caution. For example, coagulase-negative Staphylococci isolates susceptible to daptomycin were only reported by four facilities, three in the central region and one in the northern region. This data may not be representative of the entire state.

5. *Why are only certain antibiotic and organism combinations represented?*

The data represent the most clinically useful combinations as well as those combinations where multiple facilities reported data. Other data may be useful, however this report was limited by what each facility reported. Additionally, not all facilities identify and report susceptibilities in a similar manner. For example, some facilities will identify *S. epidermidis*, a species belonging to the genus Staphylococcus, and report out the susceptibilities for various antibiotics. The data reported by those facilities are included in the state and regional antibiogram in the *S. epidermidis* section. Some facilities do not identify their coagulase-negative Staphylococci to the species level. Those facilities would report *S. epidermidis* susceptibilities as coagulase-negative Staphylococci along with other species belonging to that group. The data reported by those facilities are included in the state and regional antibiogram in the Coagulase-negative Staphylococci section.

6. *Who should I contact if I have questions about the state and regional antibiogram?*

Please contact Shaina Bernard, the Antimicrobial Resistance Coordinator at the Virginia Department of Health. She can be reached by email at: hai@vdh.virginia.gov.

Antibiotic Abbreviations

Amik = Amikacin	Clinda = Clindamycin	Nitr = Nitrofurantoin
Amp/sul = Ampicillin/sulbactam	Dapto = Daptomycin	Oxa = Oxacillin
Aztr = Aztreonam	Erythr = Erythromycin	PCN = Penicillin
Cefaz = Cefazolin	Gent = Gentamicin	Pip/tazo = Piperacillin/tazobactam
Cefep = Cefepime	Levo = Levofloxacin	SMX/TMP = Sulfamethoxazole/trimethoprim
Ceftaz = Ceftazidime	Linez = Linezolid	Tetra = Tetracycline
Ceftr = Ceftriaxone	Mero = Meropenem	Tobra = Tobramycin
Cipro = Ciprofloxacin	Naf = Nafcillin	Vanc = Vancomycin

References

1. CDC. Antibiotic Resistance and Patient Safety Portal: <https://arpsp.cdc.gov/>
2. CDC. *Antibiotic Resistance Threats in the United States, 2019*: <https://www.cdc.gov/drugresistance/biggest-threats.html>
3. CDC. Healthcare-Associated Infections: <https://www.cdc.gov/hai/index.html>
4. Clinical & Laboratory Standards Institute: <https://clsi.org/>