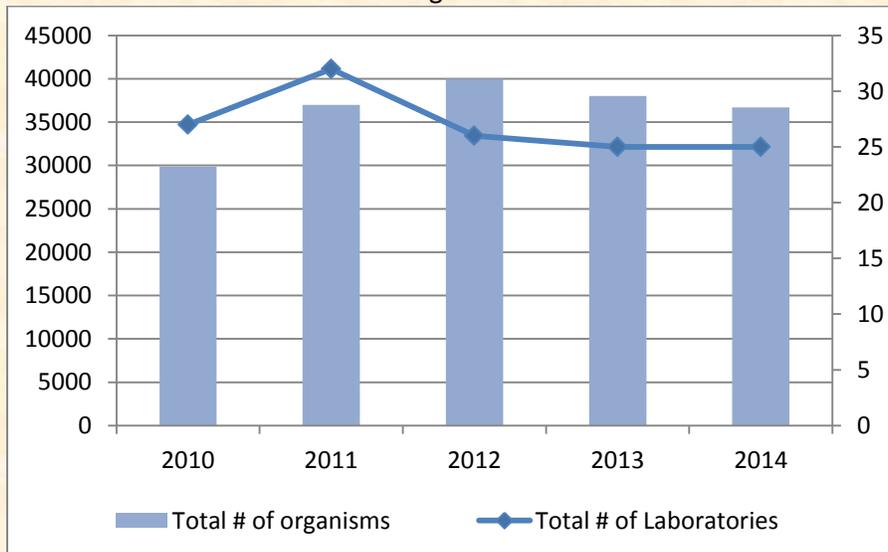


**ANTIBIOGRAM FOR SELECTED BACTERIA OF PUBLIC HEALTH AND CLINICAL SIGNIFICANCE:
ISOLATES COLLECTED BY CLINICAL LABORATORIES IN MONTANA**

The Montana Department of Public Health and Human Services Public Health Laboratory monitors antimicrobial susceptibility testing (AST) and has provided a statewide antibiogram annually since 2005. For the 2014 analyses, AST data were collected from 25 laboratories and over 36,000 isolates were tested throughout the state. A five year analysis shows that these numbers are typical of what has been reported, especially over the past three years (Figure 1). Data from each participating laboratory are compiled to create a statewide antibiogram using the methodology described by the Clinical and Laboratory Standards Institute (CLSI)¹. Data are presented as the mean \pm standard error of the mean (SEM) and variability is also assessed through the calculation of a coefficient of variation (CV). When the CV exceeds 20% it is annotated on the antibiogram and can be due to a single outlier, low sample number, or significant differences amongst values reported between facilities.

Figure 1



Based on antibiogram results, rare and improbable susceptibility patterns continue to be reported to providers. In some cases, the occurrence of even one of these susceptibility patterns would be of public health significance. These results raise a concern over possible errors in methodology, a concern that is exacerbated by the fact that none of the isolates were referred for confirmatory testing. It is important that laboratorians understand the potential significance of unusual resistance patterns so deviations from the expected will be recognized and reported. This can be accomplished by reviewing intrinsic resistance tables in CLSI document M-100, *Performance Standards for Antimicrobial Susceptibility Testing*² and by consulting statewide data. Invalid results may have significant impact on treatment of individual patients and on public health outcomes. In most instances, unexpected or improbable data do not affect the average percentage rates for the state-wide antibiogram, but they do convey potentially erroneous susceptibility data to local providers.

The present analyses include the reporting of resistant organisms of major public health significance. Based on the 2014 antibiogram data, 62 isolates reported in the *Enterobacteriaceae* family (*E. coli*, *K. pneumoniae*, *Enterobacter spp.*) are potential Carbapenem-Resistant *Enterobacteriaceae* (CRE) organisms. 47 suspected CRE isolates were submitted to the MT Public Health Laboratory (MTPHL) for confirmation in 2014, a 31% decrease from the 68 submitted in 2013 (Figure 2). CREs are categorized as “urgent threats” in a recently published CDC document³, and, by rule⁴, these isolates should be forwarded to the MTPHL. Of the 47 CRE specimens referred to MTPHL in 2014, only four isolates showed evidence of carbapenemase production using the Modified Hodge test, which is up from just two confirmations last year. Another finding of interest was the reporting of Vancomycin-Resistant *Enterococcus* species (VRE). Of isolates differentiated and reported as *E. faecalis* or *E. faecium*, 101 (4% of total tested; a 1% decrease from 2013) were reported as not susceptible to Vancomycin. The aforementioned CDC report lists these organisms as “serious threats”, with VRE-associated illness causing more than 1000 deaths per year in the U.S.

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Figure 2

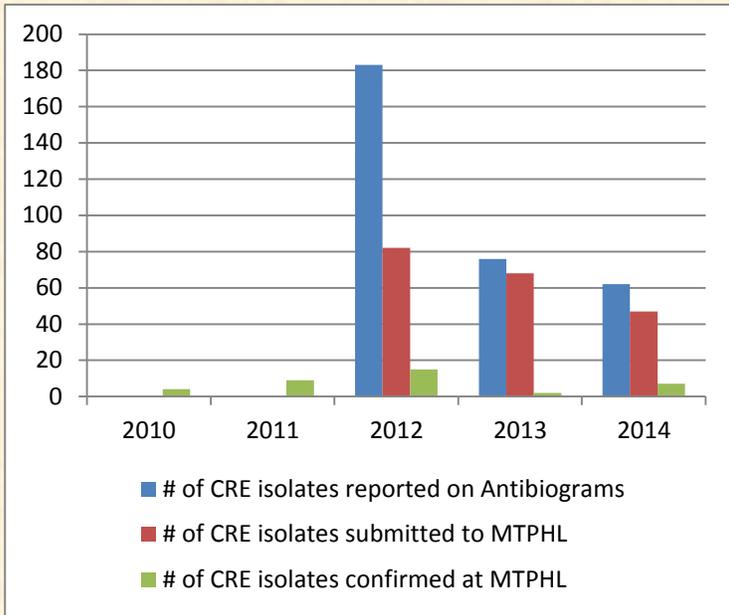
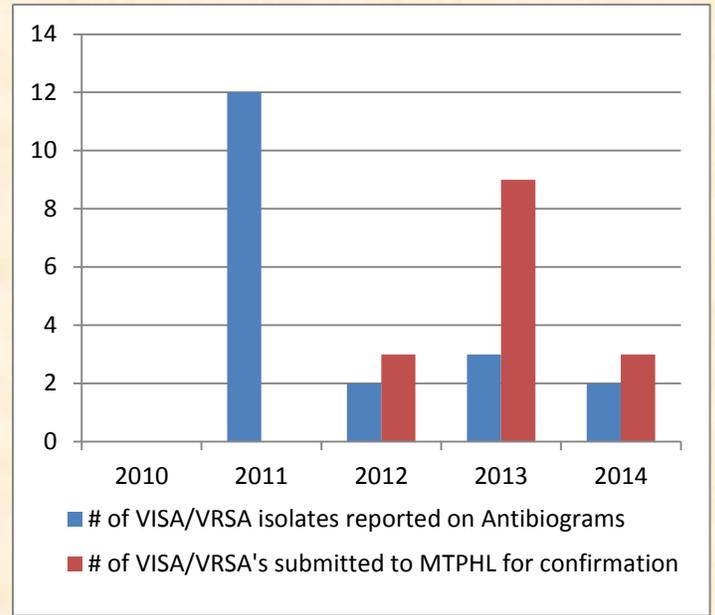
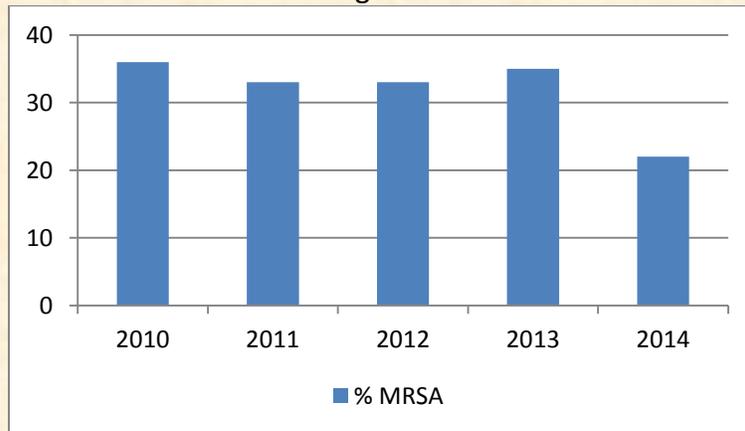


Figure 3



Over 2,000 isolates were designated as Methicillin-Resistant *Staphylococcus aureus* (MRSA) for 2014 (22% of all *S. aureus* isolates), which is 13% lower than those found in the 2013 analyses (Figure 4). 4,174 isolates were reported as Methicillin- Sensitive *Staphylococcus aureus* (MSSA); however, four of these isolates were also reported as Intermediate or Resistant to Vancomycin (i.e. VISA and VRSA). According to MTPHL 2014 records, three suspected VISA/VRSA isolates were submitted for confirmation from three different facilities. Under the updated rules in the Laboratory Reporting of Communicable Diseases in Montana⁴, all suspected or confirmed isolates of CRE and VISA/VRSA are to be submitted to the Public Health Laboratory for confirmation and further characterization.

Figure 4



The emergence of antimicrobial resistance is a global public health concern. The Montana Public Health Laboratory continues to work with our clinical laboratory partners on recognizing and referring isolates with antimicrobial resistance patterns that are of public health significance by offering access to CLSI M100 tables, promoting training opportunities, and providing antimicrobial resistance confirmatory testing.

Footnotes:

- 1) Analysis and Presentation of Cumulative Antimicrobial Susceptibility Test Data; Approved Guideline-Third Edition. CLSI document M39-A3. Wayne, PA: Clinical and Laboratory Standards Institute; 2009.
- 2) Performance Standards for Antimicrobial Susceptibility Testing; Twenty Second Informational Supplement. CLSI document M100-S23. Wayne, PA: Clinical and Laboratory Standards Institute; 2014.
- 3) Antibiotic Resistance Threats in the United States, 2013. Atlanta, GA: Centers for Disease Control and Prevention; 2013.
- 4) Laboratory Reporting of Communicable Diseases in Montana (June 2013); <http://www.dphhs.mt.gov/publichealth/lab/documents/LABDPHHSdiseaseReportingtoLHJ.pdf>
- 5) Mean ± SEM was calculated using the percent susceptible value submitted by each laboratory for each drug/organism combination. N values (i.e. number of laboratory submittals) ranged from 2 to 26

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2014

Gram Positive Isolates	# of isolates (all sources)	penicillins			Trimethoprim-Sulfamethoxazole	Rifampin	Vancomycin	Tetracycline	Linezolid	Daptomycin	Meropenem	cephems		Levofloxacin	macrolides			# of isolates (urine only)	quinolones				
		Penicillin	Ampicillin	Oxacillin								Cefotaxime	Ceftriaxone		Azithro, Clarithro, or Erythromycin	Clindamycin	Erythromycin		Ciprofloxacin	Levofloxacin	Norfloxacin	Nitrofurantoin	Tetracycline
<i>S. aureus (non-differentiated)</i>	2850	1431 20.3 ± 1.6		3076 67. ± 3.3	3076 98.2 ± 0.5	1685 99.8 ± 0.2	2796 100 ± 0.0	2738 97.1 ± 0.5	2111 99.5 ± 0.3	657 99.0 ± 1.0					1042 54.0 ± 3.8	1394 83.4 ± 2.8	792 76.5 ± 23.5	184				184 94.7 ± 2.5	
<i>S. aureus (MRSA)</i>	2021			2021 0 ± 0	1995 94.0 ± 0.3	745 97.8 ± 0.9	2021 99.3 ± 0.6	1803 91.1 ± 0.8	2021 99.7 ± 0.3	253 99.0 ± 0.0					706 70.3 ± 29.2*	586 59.7 ± 12.5	673 11.7 ± 1.8*	92				79 98.5 ± 1.3*	
<i>S. aureus (MSSA)</i>	4174	1253 23.6 ± 2.8*		4077 100 ± 0.0	4074 99.2 ± 0.3	1388 99.3 ± .8	4075 99.8 ± 0.2	3727 96.4 ± 0.6	3788 99.5 ± 7.7	162 99.0 ± 1.0*					392 90.0 ± 5.5*	1007 ± 3.5*	69.3 1260 84.3 ± 3.0*						
<i>S. pneumoniae</i>	521	328 88 ± 16.3			303 80.6 ± 3.4		377 100 ± 0.0	377 85.4 ± 2.0			212 91.5 ± 8.5*	346 96.4 ± 2.7*	286 98.5 ± 2.4*				234 59.4 ± 3.0						
<i>Enterococcus spp.</i>	1236	478 95.7 ± 3.8*	1087 90.7 ± 2.4*				1236 100 ± 2.1*		135 100 ± 0.0*	30 100 ± 0.0*								622	622 71.3 ± 7.2*	420 75.7 ± 10.8*		606 76.8 ± 19.1*	
<i>E. faecalis</i>	2412	1662 98.6 ± 0.3	2412 98.8 ± 0.4				2363 99.3 ± 0.6		2088 95.0 ± 3.5	597 99.0 ± 0.3								1572	1537 66.4 ± 3.2	1520 69.5 ± 2.7		1099 93.8 ± 3.1	502 21.9 ± 2.4
<i>E. faecium</i>	191	124 17 ± 0.0*	155 19.5 ± 5.8*				155 43.7 ± 8.1*		191 99.5 ± 0.5*									70	70 18.75 ± 3.2*	70 19.0 ± 3.1*		70 5.5 ± 2.5*	

Gram Negative Isolates	# of isolates (all sources)	aminoglycosides			b-lactam/b-lactamase inhibitor			cephems					quinolones		carbapenems			sulfonamide	penicillins		# of isolates urine only	single agents							
		Gentamicin	Tobramycin	Amikacin	Amoxicillin-Clavulanic Acid	Ampicillin-Sulbactam	Piperacillin-Tazobactam	Ticarcillin-Clavulanic Acid	Cefazolin	Cefuroxime	Cefepime	Cefotetan	Cefoxitin	Cefotaxime or Ceftriaxone	Ciprofloxacin	Levofloxacin	Ertapenem	Imipenem	Meropenem	Trimethoprim-Sulfamethoxazole		Piperacillin	Ampicillin	Cephalothin	Norfloxacin	Nitrofurantoin	Sulfisoxazole	Trimethoprim	
<i>E. coli</i>	17484	14189 94.3 ± 0.5	14354 94.6 ± 0.9	8211 96.9 ± 2.5	4754 88.4 ± 1.4	16485 70.9 ± 1.8	16014 97.8 ± 0.3	498 95.5 ± 1.3	15367 92.7 ± 1.6	2336 89.98 ± 3.1	13641 96.13 ± 1.7	927 98.5 ± 1.0	5985 96.3 ± 1.3	16014 97.3 ± 0.5	14661 79.5 ± 5.2	12853 82.6 ± 1.7	12426 99.9 ± 0.1	7804 100 ± 0.0	9818 91.9 ± 8.0	14661 84.1 ± 1.2	1841 58.8 ± 3.3	17532 62.5 ± 2.4	11148	1434 86.5 ± 4.1	1010 82.2 ± 5.9*	11148 94.8 ± 0.7		1138 80.0 ± 0.5*	
<i>K. pneumoniae</i>	3009	2664 91.3 ± 7.0	2632 89.6 ± 0.4	1127 87.0 ± 12.4	2693 83.3 ± 12.0	2482 92.2 ± 1.3	2693 84.1 ± 9.0	50 100 ± 0.0	2861 86.6 ± 6.9	332 81 ± 1.1	2514 90.2 ± 7.6	84 100 ± 0.0	1780 86.6 ± 10.9	2411 90.8 ± 7.6	2411 88.8 ± 7.5	2264 95.8 ± 1.1	2018 100.0 ± 0.0	2067 99.9 ± 0.1	1674 100.0 ± 0.0	2514 86.1 ± 7.3	32 47.0 ± 3.2	1282 3.6 ± 2.4	1206	173 56.7 ± 28.8	50 100 ± 0.0*	874 43.2 ± 6.4			
<i>Enterobacter spp.</i>	1246	1127 99.2 ± 0.3	1127 99.1 ± 0.4	569 98.7 ± 1.3	198 1.0 ± 0.5*		712 91.2 ± 2.1	41 95 ± 0.0*	41 78 ± 9.3*	53 48.5 ± 6.5*	953 98.7 ± 1.0	43 75.0 ± 23.0*		901 98.9 ± 2.1	1096 96.9 ± 1.4	1034 98.2 ± 0.7	771 87.7 ± 9.8	651 97.3 ± 1.8	600 98.8 ± 0.5	1030 94.9 ± 1.7	31 77.0 ± 2.0*	190 78.0 ± 22.0*	515			427 24.3 ± 4.6			
<i>Serratia spp.</i>	53	53 100 ± 0.0*	53 81.0 ± 3.0*	53 100 ± 0.0*							53 96.0 ± 0.6*			53 100 ± 0.0*		53 100 ± 0.0*		53 100 ± 0.0*	53 100 ± 0.0*										
<i>P. aeruginosa</i>	1486	1486 93.8 ± 4.7	1444 98.1 ± 4.7	1486 99.6 ± 0.5			1486 97.3 ± 1.7				1486 95.9 ± 0.6				1294 83.3 ± 1.9	1144 82.1 ± 2.5		803 92.5 ± 1.3	950 96.5 ± 0.8		61 100.0 ± 0.0*								
<i>Acinetobacter spp.</i>	<30																												

2014 Montana AntibioGram Notes and Legend

- Data were collected from January 1 through December 31, 2014. The antibiogram reflects data submitted by 25 clinical laboratories throughout the state.
- Data are presented for surveillance purposes only and should not be used solely in the determination of therapy for individual patients.
- Number of isolates tested for each drug is displayed in red font
- Percentage of isolates susceptible to each drug (expressed as mean ± SEM) is shown in black font⁵
- Green square indicates variability in the data set with a coefficient of variation (CV) greater than 20%
- Gray square indicates either no tests performed or fewer than thirty isolates submitted