



MISSOURI DEPARTMENT OF  
**HEALTH &**  
**SENIOR SERVICES**

# **ANTIMICROBIAL- RESISTANT INFECTIONS IN MISSOURI**

**Report to the Governor and General  
Assembly, January 2023**

Missouri Department of Health and Senior Services  
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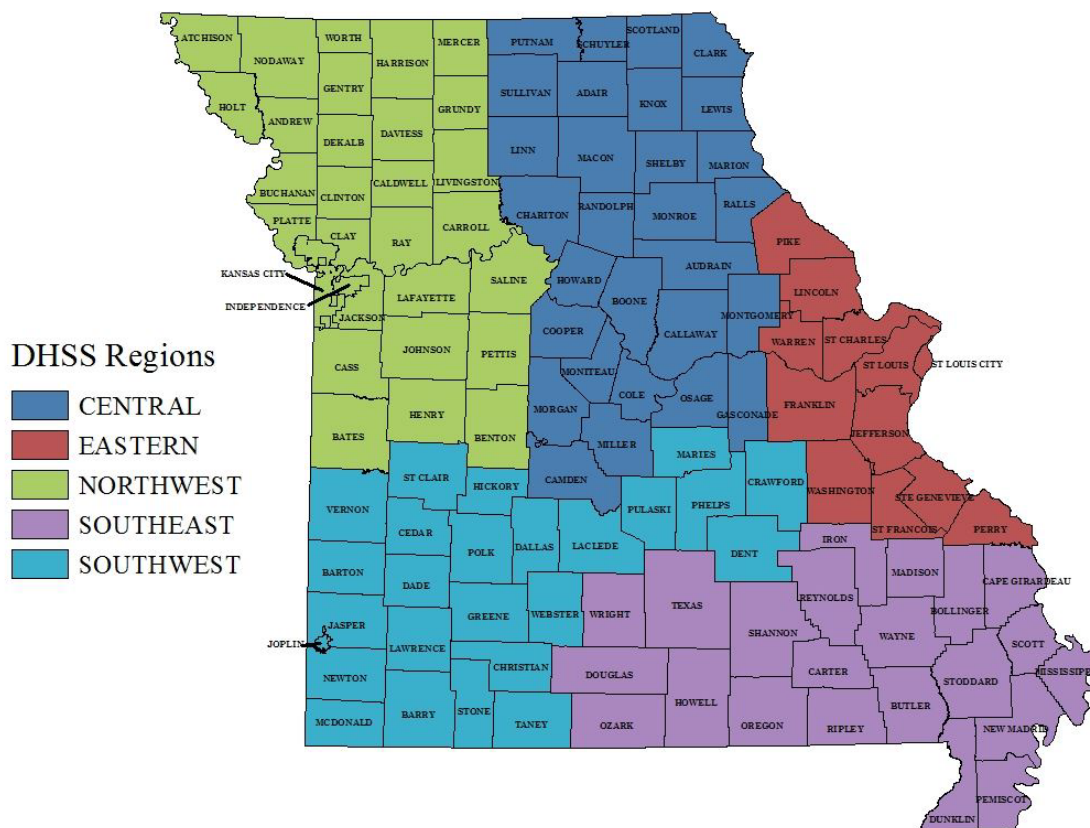
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# BACKGROUND

Per Section 192.667.21 RSMo, “The department shall make a report to the general assembly beginning January 1, 2018, and on every January first thereafter on the incidence, type, and distribution of antimicrobial-resistant infections identified in the state and within regions of the state.”

The data that follow are submitted to fulfill this requirement. Data sources include laboratory reports and reports by healthcare providers to the Missouri Department of Health and Senior Services (DHSS). The term antimicrobial resistance includes resistance to antibiotics, antifungals, and antiviral agents. The DHSS currently receives reports on select antibiotic-resistant bacteria only.

Regions used in this report are assigned as labeled in this map:



# ABOUT ANTIMICROBIAL-RESISTANT INFECTIONS

The introduction of antibiotics has greatly reduced morbidity and mortality worldwide. However, overuse of these medications has caused bacteria to develop resistance to antibiotics, making infections more expensive and harder to treat. Some bacteria have developed pan-resistance, or resistance to all antibiotics. In addition, some antibiotic-resistant bacteria are able to share the genetic material that gives them the ability to resist antibiotics with other bacteria that have not developed the ability on their own. According to the [\*Antibiotic Resistance Threats in the United States: 2019\*](#) report by the Centers for Disease Control and Prevention (CDC), more than 2.8 million antibiotic-resistant infections occur each year in the United States and more than 35,000 people die as a direct result of these infections.<sup>1</sup> Antibiotic resistance is an urgent public health concern.

The reporting period for the Missouri specific data included in this report is from Oct. 1, 2021 – Sept. 30, 2022.

## HEALTHCARE-ASSOCIATED ANTIMICROBIAL-RESISTANT INFECTIONS

Hospital-acquired or healthcare-associated infections (HAIs) are infections a patient can contract while receiving care in a healthcare facility. These infections may be associated with the use of invasive medical devices, surgical procedures, or gaps in infection control. The CDC estimates that on any given day, about 1 out of 31 hospital patients has at least one HAI.<sup>2</sup>

The Missouri Nosocomial Infection Control Act of 2004 mandated that nosocomial methicillin-resistant *Staphylococcus aureus* (MRSA) and nosocomial vancomycin-resistant Enterococci (VRE) be included in the list of reportable diseases or conditions. Carbapenem-Resistant

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<sup>1</sup> Centers for Disease Control and Prevention (2019). Antibiotic Resistance Threats in the United States, 2019. Retrieved from <https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf>

<sup>2</sup> Centers for Disease Control and Prevention (Updated 2018). Healthcare-Associated Infections-HAI Data. Retrieved from <https://www.cdc.gov/hai/data/index.html>

Enterobacterales (formerly known as Enterobacteriaceae) (CRE) were added to the list of reportable conditions in Missouri in 2018. The final CRE case definition was released in December of 2018.<sup>3</sup> Facilities began reporting CRE data in the fourth quarter of 2018.

Cases of MRSA, VRE and CRE are reported quarterly in aggregate from 285 facilities, which include hospitals and ambulatory surgery centers, throughout Missouri. It is important to note that district cases are assigned based on the healthcare facility address where an individual sought care rather than where they reside; therefore, these numbers do not represent the geographic distribution of these infections across Missouri. This undoubtedly results in greater case counts in districts with more healthcare facilities. All other conditions are reported based on the patient's home address.

Antimicrobial susceptibility results are not required to be reported for most conditions. It should be noted that the data provided are case counts, not rates of infection. The reported cases included in this report should not be considered a representative of all drug-resistant infections in Missouri.

The SARS-CoV-2 pandemic impacted data collection and reporting of antimicrobial resistant infections in Missouri as well as national data. According to the [\*2022 Special Report: Covid-19 U.S. Impact on Antimicrobial Resistance\*](#) by CDC, the data that is available from 2020 shows significant increases in antimicrobial resistant infections compared to 2019.<sup>4</sup> As we have shifted back to pre-pandemic response and activities, Missouri has seen an increase in antimicrobial resistant infections.

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<sup>3</sup> Missouri Department of Health and Senior Services. (2019). CRE Reporting. Retrieved from <https://health.mo.gov/living/healthcondiseases/communicable/communicabledisease/pdf/cre-case-definitions.pdf>

<sup>4</sup>Centers for Disease Control and Prevention (2022).2022 Special Report Covid-19 U.S. Impact on Antimicrobial Resistance. Retrieved from <https://www.cdc.gov/drugresistance/pdf/covid19-impact-report-508.pdf>

## ***METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA)***

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a type of bacteria that is resistant to several antibiotics used to treat *Staphylococcus aureus* (staph) infections. Infections can range from skin infection to pneumonia to bloodstream infections.<sup>5</sup> The data below include positive results reported in aggregate from all body sites monitored routinely by the reporting facilities. Intermediate sensitivities are reported as resistant in accordance with 19 CSR 20-20.020(13).<sup>6</sup>

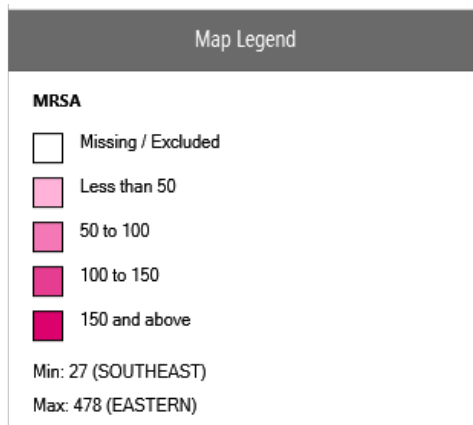
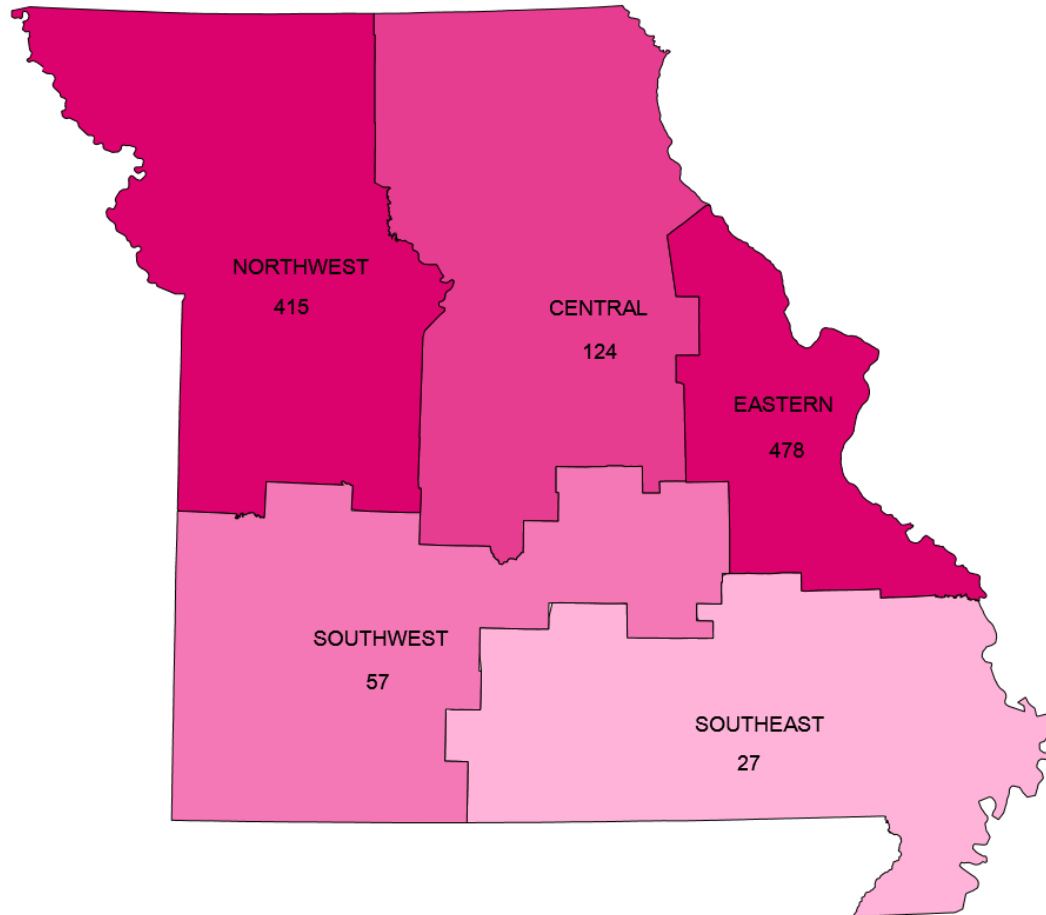
MRSA Cases Meeting the Nosocomial Reporting Requirement in Missouri by District, October 1, 2021 – September 30, 2022

<b>District</b>	<b>Cases</b>
Central	124
Eastern	478
Northwest	415
Southeast	27
Southwest	57
Statewide Total	1101

<sup>5</sup> Centers for Disease Control and Prevention. (2019). Methicillin-resistant *Staphylococcus aureus* (MRSA): General Information. Retrieved from: <https://www.cdc.gov/mrsa/community/index.html>

<sup>6</sup> Missouri Secretary of State. Code of State Regulations, Title 19 – Department of Health and Senior Services, Division 20 – Division of Community and Public Health, Chapter 20 – Communicable Diseases. Retrieved from: <https://www.sos.mo.gov/cmsimages/adrules/csr/current/19csr/19c20-20.pdf>

# Map of MRSA Cases Meeting the Nosocomial Reporting Requirement in Missouri by District, October 1, 2021 – September 30, 2022



## ***VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE)***

Vancomycin-resistant Enterococci (VRE) refers to bacteria in the *Enterococcus* genus that have developed resistance to the antibiotic vancomycin.<sup>7</sup> This antibiotic is indicated for the treatment of life-threatening bacterial infections that have been unresponsive to other antibiotics and is considered an antibiotic of last resort. The data below include positive results reported in aggregate from all body sites monitored routinely by the facility. Intermediate sensitivities are reported as resistant in accordance with 19 CSR 20-20.13.

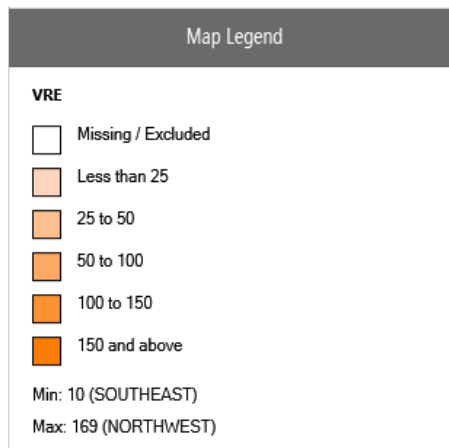
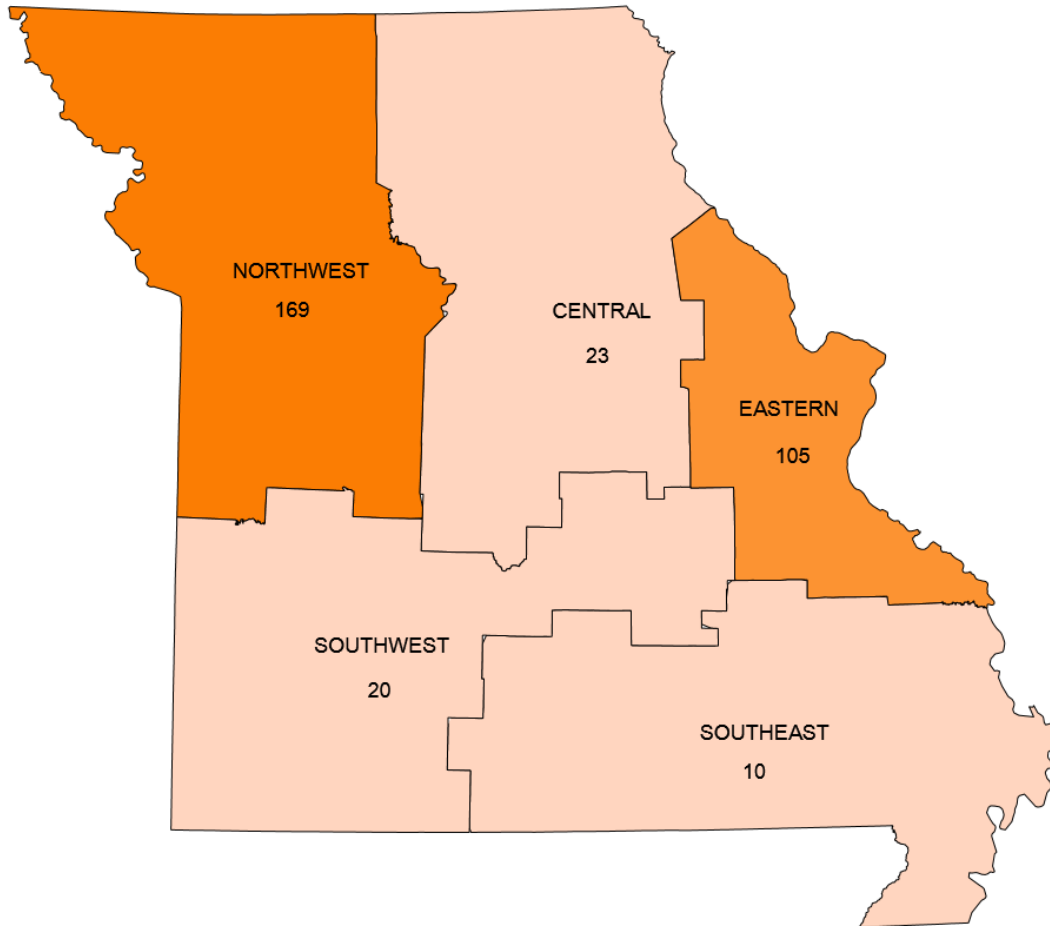
VRE Cases Meeting the Nosocomial Reporting Requirement in Missouri by District, October 1, 2021 – September 30, 2022

<b>District</b>	<b>Cases</b>
Central	23
Eastern	105
Northwest	169
Southeast	10
Southwest	20
Statewide Total	327

<sup>7</sup> Centers for Disease Control and Prevention. (2019). Healthcare-Associated Infections: Vancomycin-resistant Enterococci (VRE) In Healthcare Settings. Retrieved from: <https://www.cdc.gov/hai/organisms/vre/vre.html>



# Map of VRE Cases Meeting the Nosocomial Reporting Requirement in Missouri by District, October 1, 2021 – September 30, 2022



## ***CARBAPENEM-RESISTANT ENTEROBACTERALES (CRE)***

Carbapenem-resistant Enterobacterales (CRE) refers to bacteria in the family of Enterobacterales (e.g. *Escherichia coli*, *Klebsiella*, etc.) that are resistant to carbapenem antibiotics. This class of antibiotics is reserved for severe infections, such as those that are known or suspected to be resistant to other antibiotics. Carbapenems are considered to be drugs of last resort. The CDC has ranked CRE as one of the top five most urgent, high-consequence antimicrobial-resistant threats.<sup>8</sup>

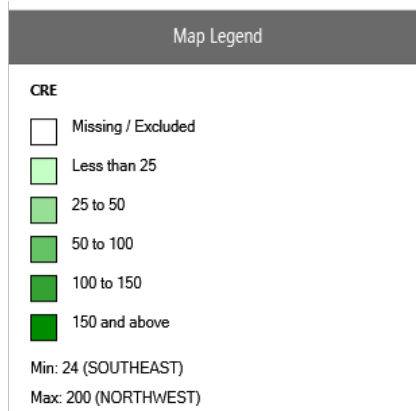
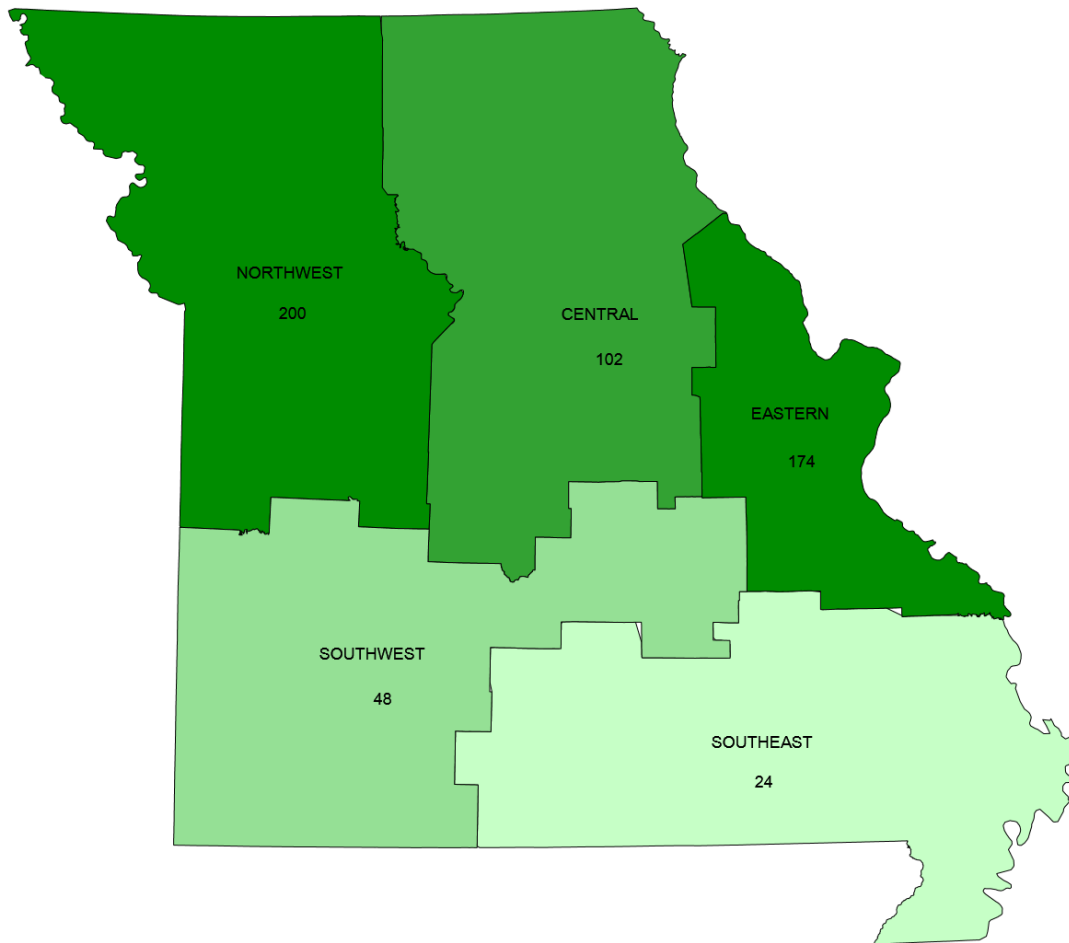
Some CRE produce carbapenemase, an enzyme that breaks down carbapenems. These CRE, known as Carbapenemase-producing CRE (CP-CRE), are an emerging public health threat that require heightened surveillance and a timely follow-up investigation. CP-CRE can spread the genetic material that encodes for the carbapenemase to other bacteria, facilitating the spread of antibiotic resistance. Nosocomial CRE were added as a reportable condition in Missouri in 2018.

CRE Cases Meeting the Nosocomial Reporting Requirement and CP-CRE Cases Reported in Missouri, October 1, 2021 – September 30, 2022

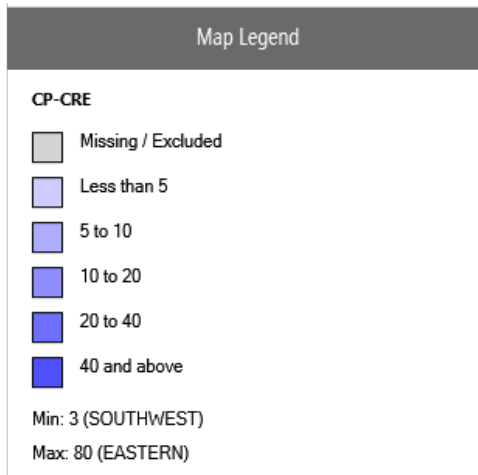
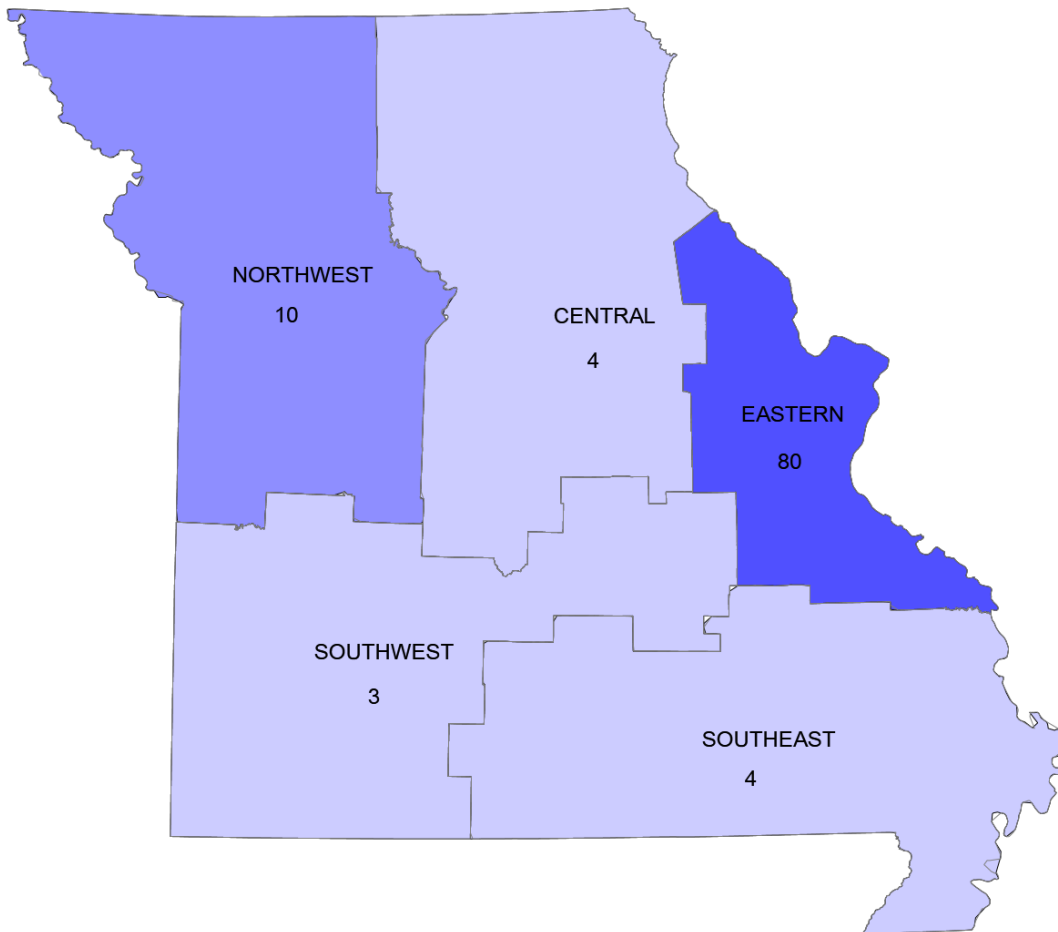
<b>District</b>	<b>CRE</b>	<b>CP-CRE</b>
Central	102	4
Eastern	174	80
Northwest	200	10
Southeast	24	4
Southwest	48	3
Statewide Total	548	101

<sup>8</sup> Centers for Disease Control and Prevention. (2020). *Antibiotic/Antimicrobial Resistance (AR/AMR) Biggest Threats and Data*. Retrieved from [https://www.cdc.gov/drugresistance/biggest-threats.html?CDC\\_AA\\_refVal=https%3A%2F%2Fwww.cdc.gov%2Fdrugresistance%2Fbiggest\\_threats.html](https://www.cdc.gov/drugresistance/biggest-threats.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fdrugresistance%2Fbiggest_threats.html)

# Map of CRE Cases Meeting the Nosocomial Reporting Requirement Cases Reported in Missouri, October 1, 2021 – September 30, 2022



# Map of CP-CRE Cases Reported in Missouri, October 1, 2021 – September 30, 2022



## ***CARBAPENEM-RESISTANT ACINETOBACTER (CRAB)***

*Acinetobacter* is a group of bacteria found in the environment that can live for long periods of time on surfaces or shared medical equipment if they are not properly cleaned. Infections typically occur in patients in healthcare settings, especially those with wounds or indwelling medical devices such as catheters or ventilators. *Acinetobacter* can cause blood, urinary tract, lung, or wound infections. It can also live in patients without causing symptoms, but still be easily spread to others through contact with infected surfaces or person to person, often via contaminated hands.

*Acinetobacter* resistant to carbapenem antibiotics are called carbapenem-resistant *Acinetobacter*. Carbapenem-resistant *Acinetobacter baumannii* (CRAB) are highly antibiotic-resistant bacteria for which few treatment options exist. Carbapenemase-producing CRAB (CP-CRAB) can spread the genetic material that encodes for the carbapenemase to other bacteria, facilitating the spread of antibiotic resistance. The CDC has ranked CRAB among the top five most urgent, high-consequence antimicrobial-resistant threats.<sup>9</sup>

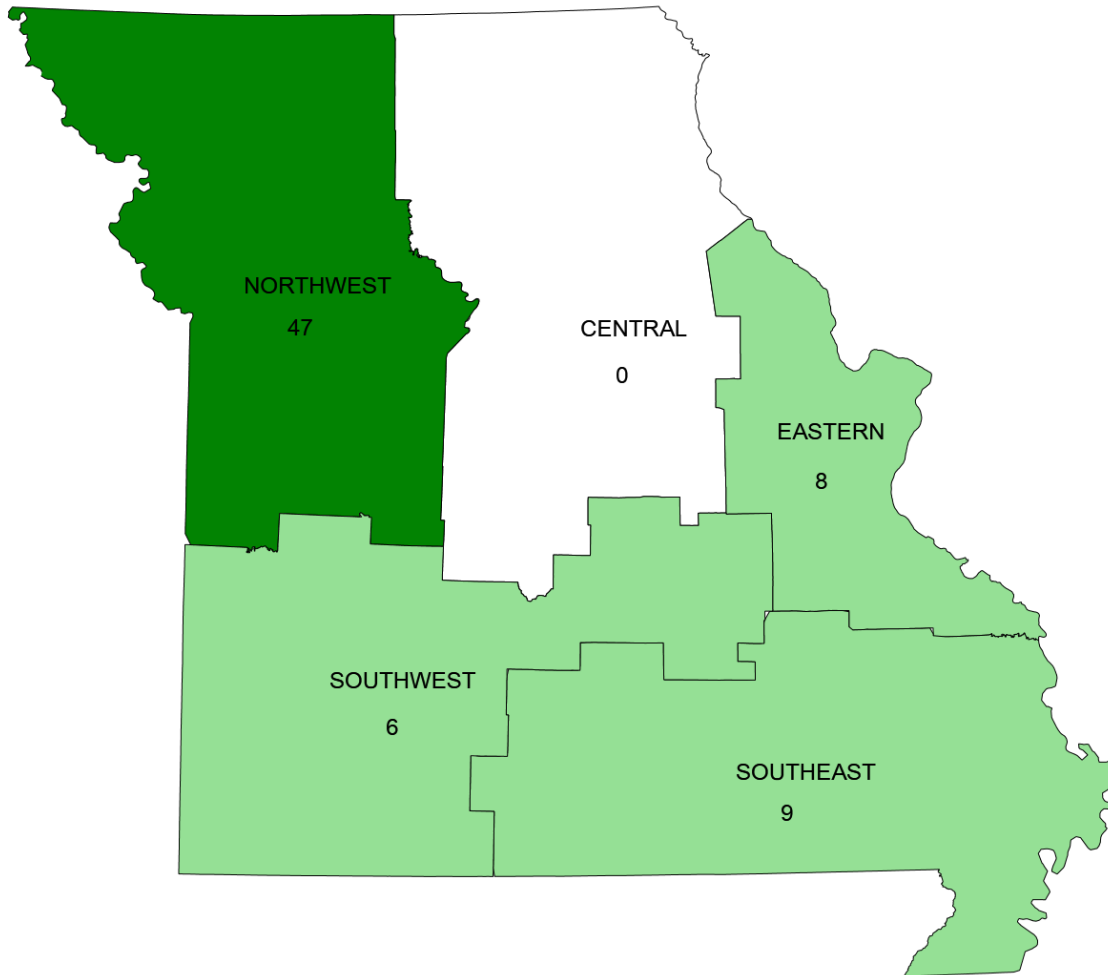
CP-CRAB Cases Reported in Missouri, October 1, 2021 – September 30, 2022

<b>District</b>	<b>Cases</b>
Central	0
Eastern	8
Northwest	47
Southeast	9
Southwest	6
Statewide Total	75*






\* Includes 5 cases where District is Unknown

<sup>9</sup> Centers for Disease Control and Prevention. (2021). *Antibiotic/Antimicrobial Resistance (AR/AMR) Biggest Threats and Data*. Retrieved from [https://www.cdc.gov/drugresistance/biggest-threats.html?CDC\\_AA\\_refVal=https%3A%2F%2Fwww.cdc.gov%2Fdrugresistance%2Fbiggest\\_threats.html](https://www.cdc.gov/drugresistance/biggest-threats.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fdrugresistance%2Fbiggest_threats.html)

# Map of CP-CRAB Cases Reported in Missouri, October 1, 2021 – September 30, 2022



### Map Legend

- CP-CRAB**
-  Missing / Excluded
  -  Less than 5
  -  5 to 10
  -  10 to 20
  -  20 to 40
  -  40 and above

Min: 6 (SOUTHWEST)  
Max: 47 (NORTHWEST)

## ***CARBAPENEM-RESISTANT PSEUDOMONAS AERUGINOSA (CRPA)***

*Pseudomonas aeruginosa* is a type of bacteria commonly causing healthcare associated infections in the blood, lungs, or other parts of the body after surgery. Multidrug-resistant *Pseudomonas* has been designated as a serious threat by the CDC.<sup>10</sup> Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) infections are not currently included in the list of reportable diseases in Missouri.

The Missouri State Public Health Laboratory, in collaboration with the CDC, initiated a sampling program for CRPA in April of 2019. The objective of the program was to assess the burden of Carbapenemase-producing CRPA (CP-CRPA) nationally. Participating facilities in Missouri voluntarily submit samples and a random subset of 10 CRPA submitted each month are tested.

CP-CRPA Cases Reported in Missouri, October 1, 2021 – September 30, 2022

	<b>CP-CRPA</b>
Statewide Total	5

<sup>10</sup> Centers for Disease Control and Prevention. (Updated 2019). *Pseudomonas aeruginosa in Healthcare Settings*. Retrieved from <https://www.cdc.gov/hai/organisms/pseudomonas.html>

## ***DRUG-RESISTANT TUBERCULOSIS***

*Mycobacterium tuberculosis* is a bacterium that causes the disease tuberculosis (TB). TB disease can occur in the lungs or other sites, including the brain, kidneys, or spine and can spread from person to person through the air. Worldwide, TB is the leading cause of death from infectious disease. Drug-resistant TB is relatively uncommon in the United States when compared to developing countries, though rates are increasing.

There are different types of drug-resistant TB of public health concern: Multidrug-resistant TB (MDR TB), Pre-XDR, and extensively drug-resistant TB (XDR TB). MDR TB is resistant to at least Isoniazid and Rifampin. Pre-XDR TB is caused by an organism that is resistant to isoniazid, rifampin, and a fluoroquinolone OR by an organism that is resistant to isoniazid, rifampin, and a second-line injectable (amikacin, capreomycin, and kanamycin). XDR TB is caused by an organism that is resistant to isoniazid, rifampin, a fluoroquinolone, and a second-line injectable (amikacin, capreomycin, and kanamycin) OR by an organism that is resistant to isoniazid, rifampin, a fluoroquinolone, and bedaquiline or linezolid. Treating drug-resistant TB is very costly and can take years. In 2020, CDC estimated the average cost of treating a XDR TB case was approximately \$567,000. Costs are even higher when loss of productivity is considered.<sup>11</sup> No cases of MDR TB were reported in Missouri during this reporting period. No cases of XDR TB have been reported in Missouri.

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<sup>11</sup> Centers for Disease Control and Prevention. (2022). Drug-Resistant TB. Retrieved from <https://www.cdc.gov/tb/topic/drtb/default.htm>



## ***NEISSERIA GONORRHOEAE***

Gonorrhea is a sexually transmitted disease that can affect both men and women.<sup>12</sup> According to the CDC, there are an estimated 1.6 million total cases of gonorrhea each year and about half of those cases are resistant to at least one antibiotic.<sup>13</sup> There remains one recommended antibiotic left to treat gonorrhea, and resistance is increasing. The CDC has categorized drug-resistant *Neisseria gonorrhoeae* as an urgent risk to the United States.<sup>14</sup> No cases of gonorrhea resulting from drug-resistant *Neisseria gonorrhoeae* were reported in Missouri during this reporting period.

## ***NEISSERIA MENINGITIDIS***

*Neisseria meningitidis* is a bacterium that causes meningococcal disease, a severe and often deadly infection. These infections may include meningitis, meningococemia, and sepsis.<sup>15</sup> Due to the severity of this disease, prompt antibiotic treatment is necessary, therefore antibiotic resistance is of concern. The CDC reports that rates of meningococcal disease in the United States are at a historic low.<sup>16</sup> No cases of meningococcal disease resulting from drug-resistant *Neisseria meningitidis* were reported in Missouri during this reporting period.

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<sup>12</sup> Centers for Disease Control and Prevention. (2022). Gonorrhea: Gonorrhea – CDC Fact Sheet. Retrieved from: <https://www.cdc.gov/std/gonorrhea/stdfact-gonorrhea.htm>

<sup>13</sup> Centers for Disease Control and Prevention. (Updated 2022). Combating the Threat of Antibiotic-Resistant Gonorrhea. Retrieved from: <https://www.cdc.gov/std/gonorrhea/arg/carb.htm>

<sup>14</sup> Centers for Disease Control and Prevention. (Updated 2021). Antibiotic/Antimicrobial Resistance (AR/AMR). Retrieved from: [https://www.cdc.gov/drugresistance/biggest\\_threats.html](https://www.cdc.gov/drugresistance/biggest_threats.html)

<sup>15</sup> Centers for Disease Control and Prevention. (2022). Meningococcal Disease. Retrieved from <https://www.cdc.gov/meningococcal/index.html>

<sup>16</sup> Centers for Disease Control and Prevention. (2021). Vaccines and Preventable Diseases Meningococcal Vaccination: What Everyone Should Know. Retrieved from <https://www.cdc.gov/vaccines/vpd/mening/public/index.html#how-well-they-work>

## ***STREPTOCOCCUS PNEUMONIAE***

*Streptococcus pneumoniae* is a reportable bacteria when an invasive infection occurs in a normally sterile site. The main syndromes include pneumonia, bacteremia, and meningitis. Infections can be severe or even fatal<sup>17</sup>. The CDC reports 30% of invasive infectious caused by pneumococcal bacteria are resistant to one or more antibiotics.<sup>18</sup>

Drug-resistant *Streptococcus pneumoniae* Cases Reported in Missouri, October 1, 2021 – September 30, 2022

<b>District</b>	<b>Cases</b>
Central	0
Eastern	12
Northwest	5
Southeast	1
Southwest	6
Statewide Total	24

<sup>17</sup> Centers for Disease Control and Prevention. (2020). Pneumococcal Disease: Types of Infection. Retrieved from: <https://www.cdc.gov/pneumococcal/about/infection-types.html>

<sup>18</sup> Centers for Disease Control and Prevention. (2020). Pneumococcal Disease: Drug Resistance. Retrieved from: <https://www.cdc.gov/pneumococcal/clinicians/drug-resistance.html>

## SHIGELLA

*Shigella* is a genus of bacteria that causing a diarrheal illness called shigellosis. *Shigella* is easily spread from person to person. Shigellosis outbreaks frequently occur in daycare centers due to suboptimal hygiene in small and diapered children.<sup>19</sup> Nationally, drug resistant *Shigella* cases have increased significantly since 2013.<sup>20</sup>

Drug-resistant Shigellosis Cases Reported in Missouri, October 1, 2021 – September 30, 2022

District	Cases
Central	0
Eastern	3
Northwest	2
Southeast	0
Southwest	0
Statewide Total	5

<sup>19</sup> Centers for Disease Control and Prevention. (2020). *Shigella* – Shigellosis. Retrieved from: <https://www.cdc.gov/shigella/index.html>

<sup>20</sup> Centers for Disease Control and Prevention. (2019). Drug-Resistant *Shigella*. Retrieved from: <https://www.cdc.gov/drugresistance/pdf/threats-report/shigella-508.pdf>

## ***SALMONELLA***

*Salmonella* is a genus of bacteria that causes an illness called salmonellosis. People can get Salmonella infections by consuming contaminated food or water, or touching infected animals, their feces, or their environment. In most people, symptoms include diarrhea, fever, and cramps. Some people's illness may be so severe they need to be hospitalized. Antibiotics are typically used only to treat people who have severe illness or who are at risk for it, however resistance to essential antibiotics is increasing in *Salmonella*, which can limit treatment options for people with severe infections.<sup>21</sup>

Drug-resistant Salmonellosis Cases Reported in Missouri, October 1, 2021 – September 30, 2022

<b>District</b>	<b>Cases</b>
Central	1
Eastern	4
Northwest	3
Southeast	0
Southwest	0
Statewide Total	8

## **Questions:**

Any questions about this report should be addressed to the Missouri Department of Health and Senior Services, Bureau of Communicable Disease Control and Prevention: 573-751-6113.

<sup>21</sup> Centers for Disease Control and Prevention. (2022). *Salmonella*. Retrieved from: <https://www.cdc.gov/salmonella/index.html>