



MISSOURI DEPARTMENT OF  
**HEALTH &  
SENIOR SERVICES**

# **ANTIMICROBIAL-RESISTANT INFECTIONS IN MISSOURI**

**Report to the Governor and General  
Assembly, January 2024**

**Missouri Department of Health and Senior Services  
Paula F. Nickelson, Director**

**Missouri Department of Health and Senior Services**

912 Wildwood Drive | Jefferson City, MO 65109

# ANTIMICROBIAL-RESISTANT INFECTIONS IN MISSOURI

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## 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 harder and more expensive 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 Quarter four of 2022 through Quarter three of 2023 (October 1, 2022 – September 30, 2023).

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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/antimicrobial-resistance/data-research/threats/index.html>

# HEALTHCARE-ASSOCIATED ANTIMICROBIAL-RESISTANT INFECTIONS

Hospital-acquired or healthcare-associated infections (HAIs) are infections a patient contracts while receiving healthcare 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 and/or conditions. Carbapenem-Resistant Enterobacterales (formerly known as Enterobacteriaceae) (CRE) were added to the list of reportable condition 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.

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***CDC estimates about 1 out of 31 hospital patients has at least one HAI***

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Cases of MRSA, VRE, and CRE are reported quarterly in aggregate from 199 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.

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

<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>

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.

In 2022-2023, the HAI Program saw an increase in reported cases of Carbapenemase-producing organisms (CPOs)\*.

The Healthcare-Associated Infections/Antimicrobial Resistance (HAI/AR) Program within the DHSS has been able to utilize Federal Epidemiology and Laboratory Capacity (ELC) grants to increase capacity of program activities. This has led to expanded HAI/AR program surveillance and testing at the Missouri State Public Health Laboratory (MSPHL). The increase in detected cases demonstrates success for the HAI/AR Program due to the expanded screenings, testing, and investigations the program has been able to implement in healthcare facilities throughout the state.

The HAI/AR Program is comprised of an HAI/AR Program Coordinator, a Lead Data Analyst, a Nurse Specialist in Infection Prevention, an Antimicrobial Stewardship Pharmacist, a Lead Epidemiologist, three Epidemiology Specialists, and three Public Health Environmental Officers.

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\*The CDC has moved to referring to these isolates as Carbapenemase producing organisms (CPOs), instead of the naming conventions of CP-CRE, CP-CRAB and CRPA. We will still use the previous naming condition for this report until the language in the legislation are updated to match the CDC.

## 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>4</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>5</sup>

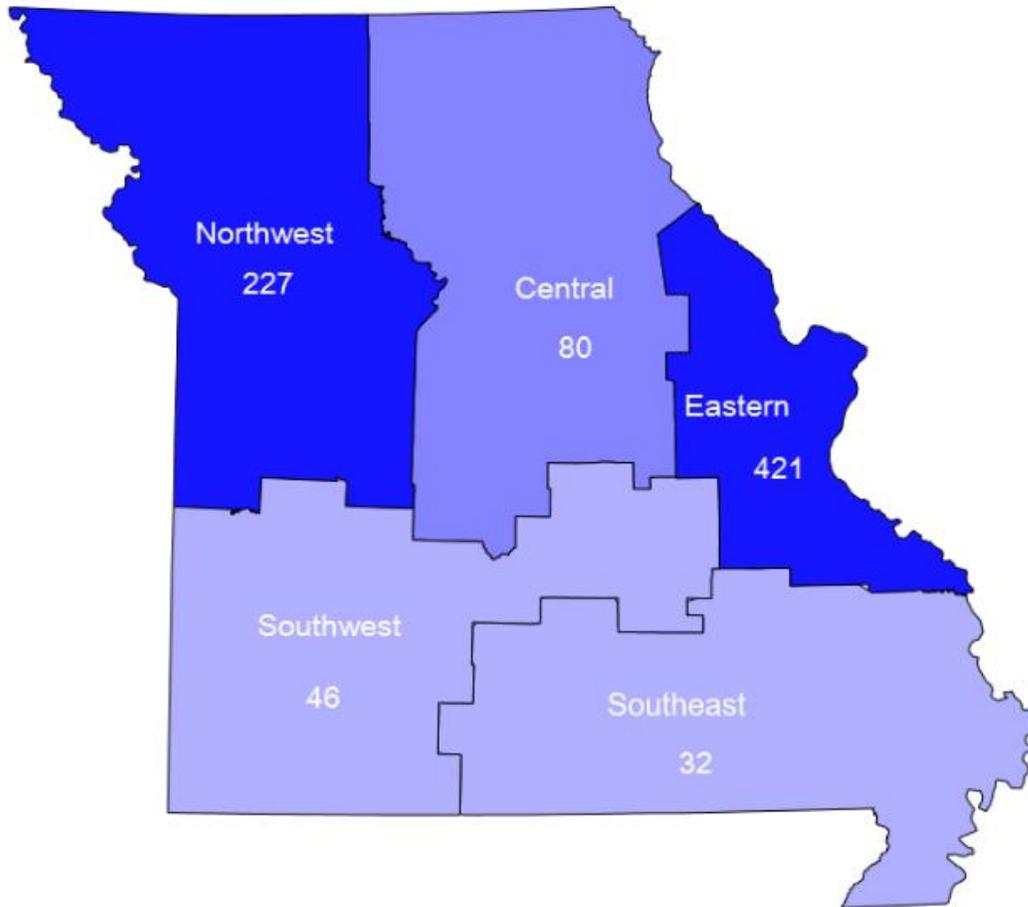
MRSA Cases Meeting the Nosocomial Reporting Requirement in Missouri by District, October 1, 2022 – September 30, 2023

District	Cases
Central	80
Eastern	421
Northwest	227
Southeast	32
Southwest	46
<b>Statewide Total</b>	<b>806</b>

<sup>4</sup> Centers for Disease Control and Prevention. (2019). Methicillin-resistant *Staphylococcus aureus* (MRSA): General Information. Retrieved from: <https://www.cdc.gov/mrsa/about/>

<sup>5</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



### Map Legend

**MRSA**

- Missing / Excluded
- Less than 25
- 25 to 50
- 50 to 100
- 100 to 150
- 150 and above

Min: 32 (SOUTHEAST)  
Max: 421 (EASTERN)

## VANCOMYCIN-RESISTANT ENTEROCOCCI (VRE)

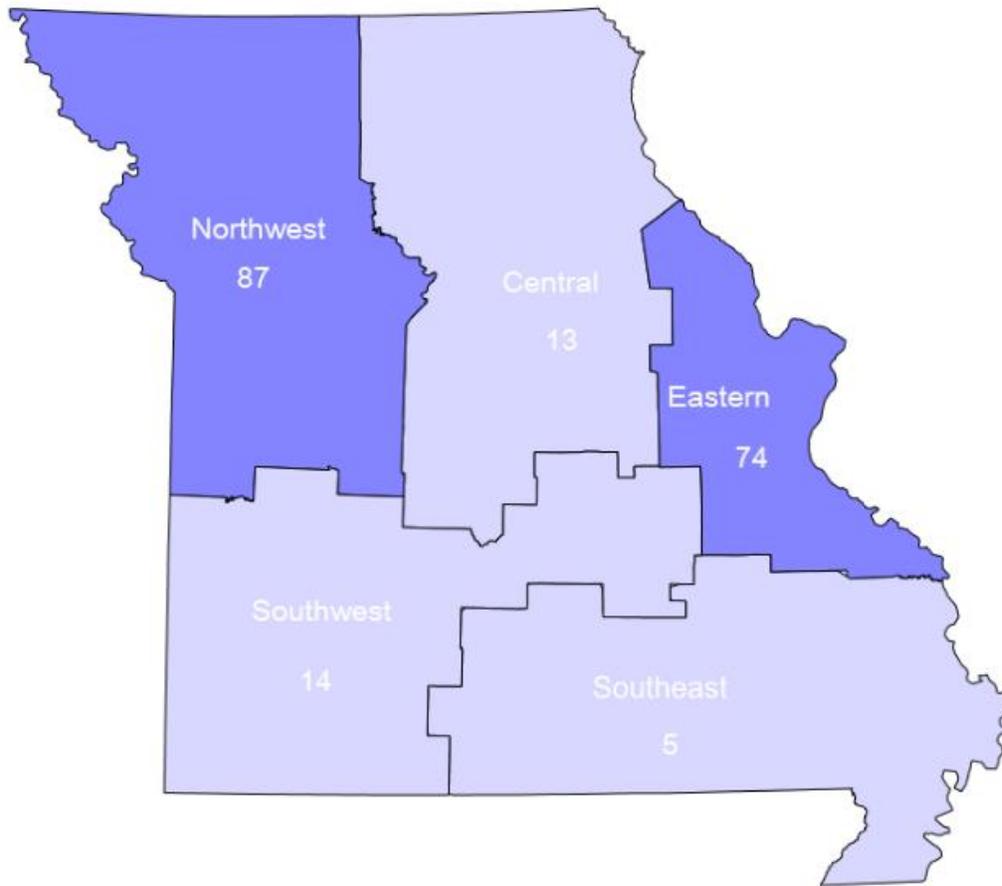
Vancomycin-resistant Enterococci (VRE) refers to bacteria in the *Enterococcus* genus that have developed resistance to the antibiotic vancomycin.<sup>6</sup> This antibiotic is indicated for the treatment of life-threatening bacterial infections that have been unresponsive to other antibiotics and is 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, 2022 – September 30, 2023

District	Cases
Central	13
Eastern	74
Northwest	87
Southeast	5
Southwest	14
<b>Statewide Total</b>	<b>193</b>

<sup>6</sup> Centers for Disease Control and Prevention. (2019). Healthcare-Associated Infections: Vancomycin-resistant Enterococci (VRE) In Healthcare Settings. Retrieved from: <https://www.cdc.gov/vre/about/>

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



#### Map Legend

- VRE**
- Missing / Excluded
  - Less than 25
  - 25 to 50
  - 50 to 100
  - 100 to 150
  - 150 and above
- Min: 5 (SOUTHEAST)  
Max: 87 (NORTHWEST)

## 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>7</sup>

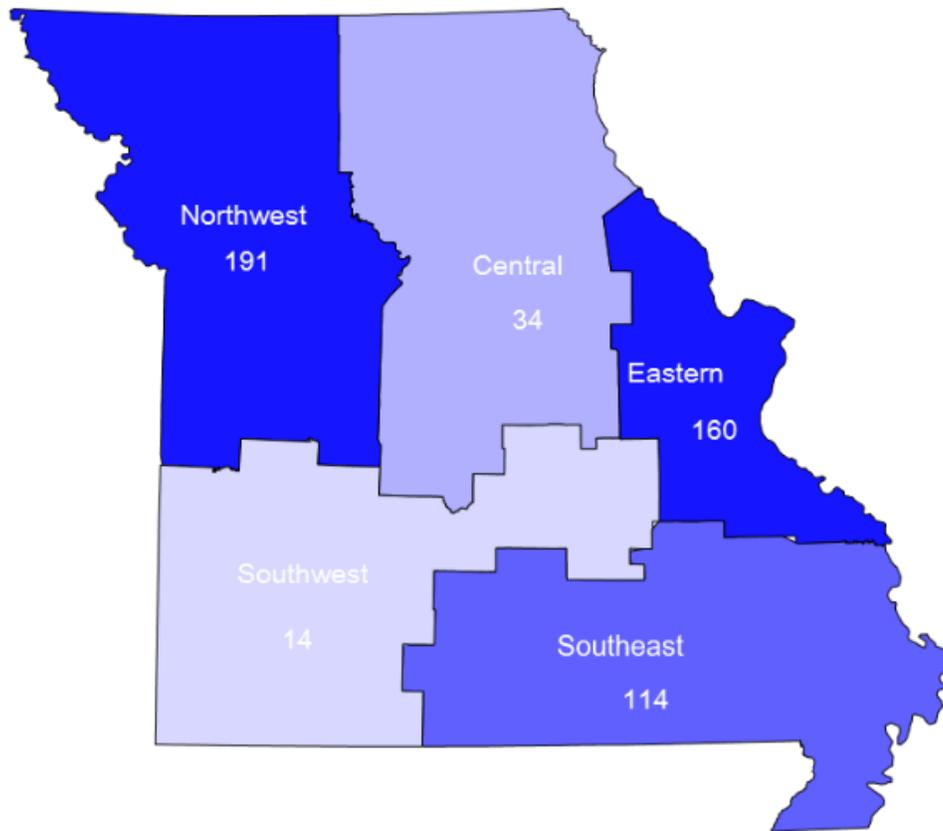
Some CRE produce carbapenemase, an enzyme that breaks down carbapenems. These CRE, known as Carbapenemase-producing CRE (CP-CRE), are an emerging public health threat that require heightened surveillance and a timely follow-up investigation. CP-CRE can spread the genetic material that encodes for the 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, 2022 – September 30, 2023

District	CRE	CP-CRE
Central	34	12
Eastern	160	76
Northwest	191	17
Southeast	114	4
Southwest	14	3
<b>Statewide Total</b>	<b>513</b>	<b>112</b>

Map of CRE Cases Meeting the Nosocomial Reporting Requirement Cases Reported in Missouri, October 1, 2022 – September 30, 2023

<sup>7</sup> Centers for Disease Control and Prevention. (2021). *Antimicrobial Resistance* Retrieved from <https://www.cdc.gov/antimicrobial-resistance/data-research/facts-stats/index.html>



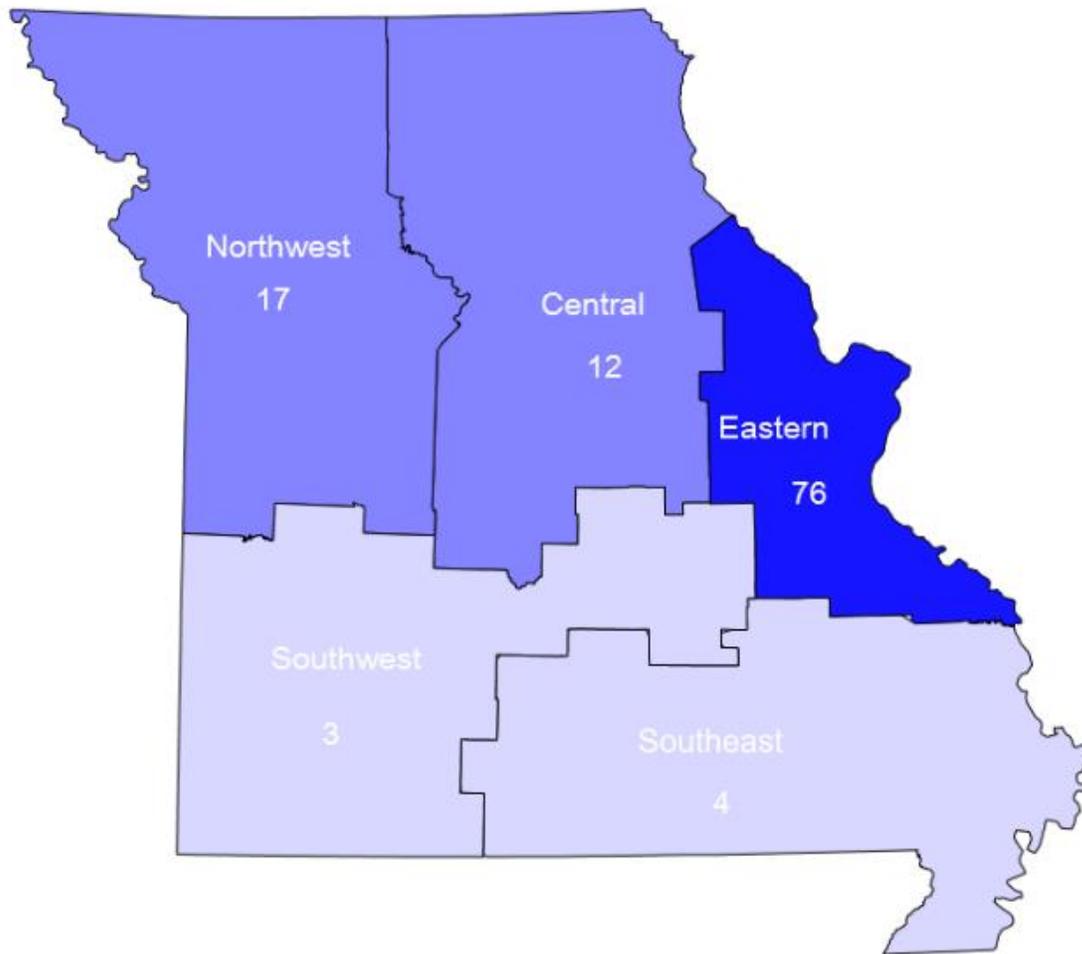
Map Legend

CRE

- Missing / Excluded
- Less than 25
- 25 to 50
- 50 to 100
- 100 to 150
- 150 and above

Min: 114 (SOUTHEAST)  
Max: 191 (NORTHWEST)

### Map of CP-CRE Cases Reported in Missouri, October 1, 2022 – September 30, 2023



#### Map Legend

- CP-CRE**
- Missing / Excluded
  - Less than 5
  - 5 to 10
  - 10 to 25
  - 25 to 50
  - 50 and above

Min: 3 (SOUTHWEST)  
Max: 76 (EASTERN)

## CARBAPENEM-RESISTANT *ACINETOBACTER*

*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.

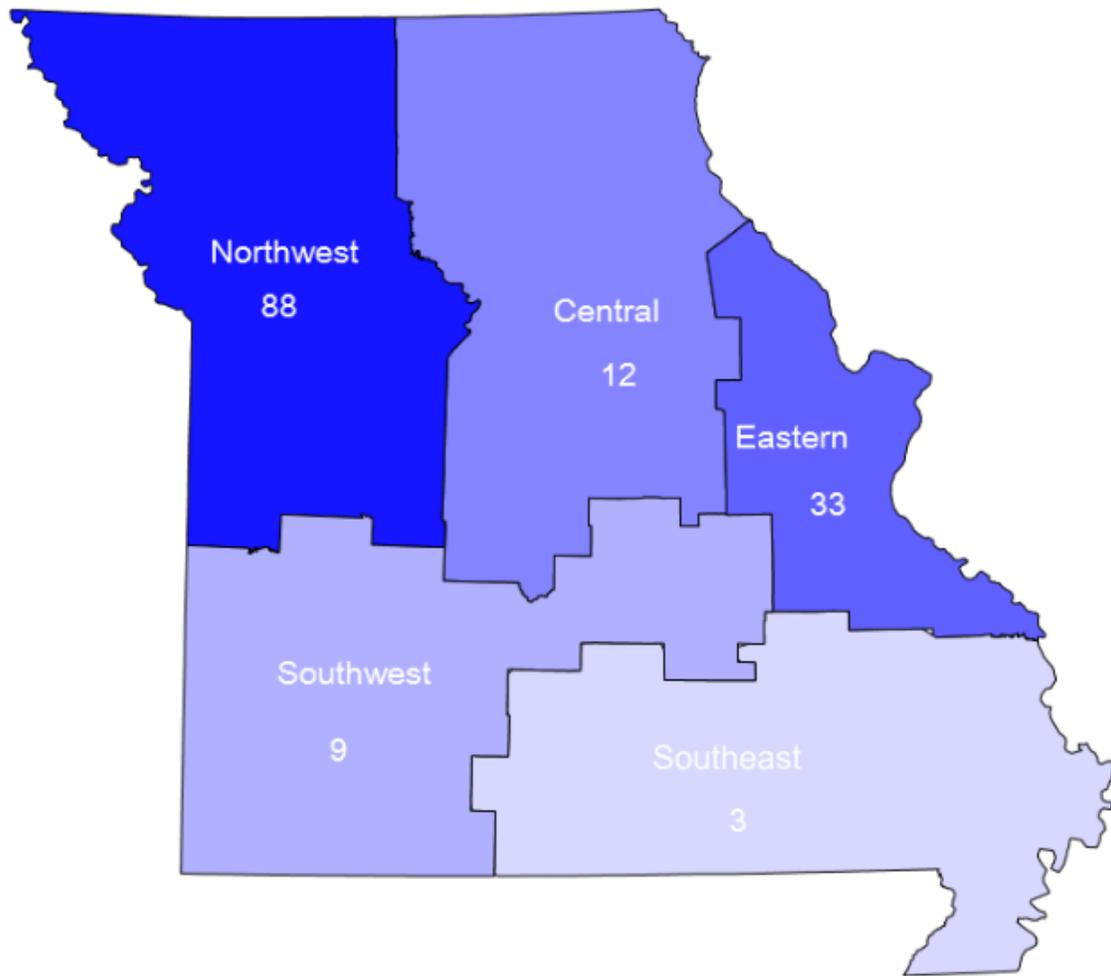
*Acinetobacter* resistant to carbapenem antibiotics are called carbapenem-resistant *Acinetobacter*. Carbapenem-resistant *Acinetobacter baumannii* (CRAB) are highly antibiotic-resistant bacteria for which few treatment options exist. Carbapenemase-producing CRAB (CP-CRAB) can spread the genetic material 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>8</sup>

CP-CRAB Cases Reported in Missouri, October 1, 2022 – September 30, 2023

District	Cases
Central	12
Eastern	33
Northwest	88
Southeast	3
Southwest	9
<b>Statewide Total</b>	<b>145</b>

Map of CP-CRAB Cases Reported in Missouri, October 1, 2022 – September 30, 2023

<sup>8</sup> Centers for Disease Control and Prevention. (2021). *Antibiotic/Antimicrobial Resistance (AR/AMR) Biggest Threats and Data*. Retrieved from <https://www.cdc.gov/antimicrobial-resistance/data-research/facts-stats/index.html>



Map Legend

CP-CRE

- Missing / Excluded
- Less than 5
- 5 to 10
- 10 to 25
- 25 to 50
- 50 and above

Min: 3 (SOUTHWEST)  
Max: 76 (EASTERN)

## 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>9</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, 2022 – September 30, 2023

	CP-CRPA
Statewide Total	9

<sup>9</sup> Centers for Disease Control and Prevention. (Updated 2019). *Pseudomonas aeruginosa in Healthcare Settings*. Retrieved from <https://www.cdc.gov/pseudomonas-aeruginosa/about/>

# DRUG-RESISTANT MYCOBACTERIUM 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>10</sup> Two 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>10</sup> Centers for Disease Control and Prevention. (2022). Drug-Resistant TB. Retrieved from <https://www.cdc.gov/tb/about/drug-resistant.html>

## **NEISSERIA GONORRHOEAE**

Gonorrhea is a sexually transmitted disease that can affect both men and women.<sup>11</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>12</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>13</sup> There is a surveillance project in Kansas City funded through the CDC. The latest report from 2021, showed that of the isolates tested for antimicrobial resistance, 39.2% of isolates were resistant to one antimicrobial and 15.5% were resistant to two antimicrobials.

## **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>14</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>15</sup> One case of meningococcal disease resulting from drug-resistant *Neisseria meningitidis* were reported in Missouri during this reporting period.

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<sup>11</sup> Centers for Disease Control and Prevention. (2022). Gonorrhea: Gonorrhea – CDC Fact Sheet. Retrieved from: <https://www.cdc.gov/gonorrhea/about/>

<sup>12</sup> Centers for Disease Control and Prevention. (Updated 2022). Combating the Threat of Antibiotic-Resistant Gonorrhea. Retrieved from: <https://www.cdc.gov/gonorrhea/hcp/drug-resistant/index.html>

<sup>13</sup> Centers for Disease Control and Prevention. (Updated 2021). Antibiotic/Antimicrobial Resistance (AR/AMR). Retrieved from: <https://www.cdc.gov/antimicrobial-resistance/data-research/facts-stats/index.html>

<sup>14</sup> Centers for Disease Control and Prevention. (2022). Meningococcal Disease. Retrieved from <https://www.cdc.gov/meningococcal/index.html>

<sup>15</sup> Centers for Disease Control and Prevention. (2021). Vaccines and Preventable Diseases Meningococcal Vaccination: What Everyone Should Know. Retrieved from <https://www.cdc.gov/meningococcal/vaccines/index.html>

## ***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>16</sup>. The CDC reports 30% of invasive infectious caused by pneumococcal bacteria are resistant to one or more antibiotics.<sup>17</sup>

Drug-resistant *Streptococcus pneumoniae* Cases Reported in Missouri, October 1, 2022 – September 30, 2023

<b>District</b>	<b>Cases</b>
Central	4
Eastern	44
Northwest	33
Southeast	9
Southwest	18
<b>Statewide Total</b>	<b>108</b>

<sup>16</sup> Centers for Disease Control and Prevention. (2020). Pneumococcal Disease: Types of Infection. Retrieved from: <https://www.cdc.gov/pneumococcal/about/>

<sup>17</sup> Centers for Disease Control and Prevention. (2020). Pneumococcal Disease: Drug Resistance. Retrieved from: <https://www.cdc.gov/pneumococcal/php/drug-resistance/index.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>18</sup> Nationally, drug resistant *Shigella* cases have increased significantly since 2013.<sup>19</sup>

Drug-resistant Shigellosis Cases Reported in Missouri, October 1, 2022 – September 30, 2023

District	Cases
Statewide Total	26

<sup>18</sup> Centers for Disease Control and Prevention. (2020). *Shigella* – Shigellosis. Retrieved from: <https://www.cdc.gov/shigella/index.html>

<sup>19</sup> Centers for Disease Control and Prevention. (2019). Drug-Resistant *Shigella*. Retrieved from: <https://www.cdc.gov/antimicrobial-resistance/media/pdfs/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>20</sup>

Drug-resistant Salmonellosis Cases Reported in Missouri, October 1, 2022 – September 30, 2023

District	Cases
Statewide Total	17

## Questions:

Any questions about this report should be addressed to the Missouri Department of Health and Senior Services, Healthcare-Associated Infections/Antimicrobial Resistance Program: 573-751-6113.

<sup>20</sup> Centers for Disease Control and Prevention. (2022). *Salmonella*. Retrieved from: <https://www.cdc.gov/salmonella/index.html>