ANTIMICROBIAL RESISTANT INFECTIONS IN MISSOURI

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Preface

This report is submitted in accordance with Section 192.667.21, RSMo, that the Missouri Department of Health and Senior Services (DHSS) shall "make a report to the general assembly… on the incidence, type, and distribution of antimicrobial-resistant infections identified in the state and within regions of the state." This annual report is issued by January 1, 2026, for the 2025 calendar year.

This report also includes highlighted activities of DHSS to control and prevent these antimicrobial-resistant infections within healthcare facilities within the state of Missouri.

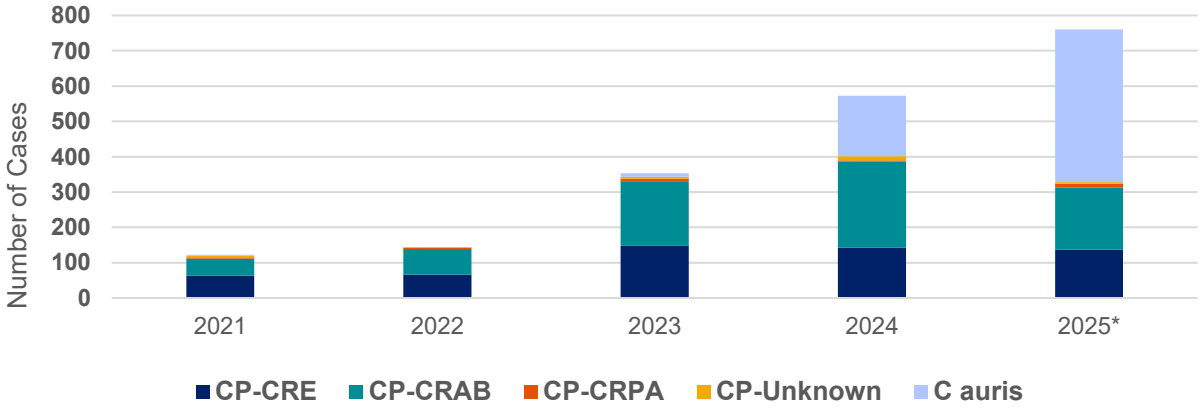
Antimicrobial Resistant Infections

Antimicrobial resistance occurs when a microorganism develops resistance to a medication typically used to treat the infection. Antimicrobial resistance is an emerging global public health threat due to its difficulty to treat, requiring the use of less desirable treatment options for patients. These less desirable treatment options can cause more serious side effects and can be more costly for both the patient and the healthcare facility, resulting in economic impacts. In some cases, there may be no effective treatment options available, often resulting in increased length of healthcare stays, increased toxicities to the patient, and increased risk of patient death[1]. Antimicrobial resistance can occur in several different ways or mechanisms. In some cases, genetic material that causes antibiotic resistance can even be shared to other bacteria in the environment[1]. Resistant infections can occur in both healthcare and community settings; however, novel and emerging resistance is often first identified in healthcare settings and, if allowed to transmit, they can spillover into communities[2].

In 2004, Missouri began requiring hospitals and ambulatory surgery centers to report aggregate numbers of healthcare-associated, also known as nosocomial, infections for Methicillin-resistant *Staphylococcus aureus* (MRSA) and Vancomycin-resistant Enterococci (VRE) on a quarterly basis, as part of the "Missouri Nosocomial Infection Control Act". In 2009, the Omnibus Bill required all states that received Preventative Health and Health Services (PHHS) Block Grant funding to implement a plan to reduce healthcare-associated infections. In 2018, Carbapenemase-Producing Carbapenem-Resistant Enterobacterales (CP-CRE) were added to Centers for Disease Control and Prevention's (CDC's) National Notifiable Disease Surveillance System (NNDSS) and Carbapenem-Resistant Enterobacterales (CRE) was added to the quarterly reporting requirement in Missouri. Clinical cases of *Candida auris* were added to NNDSS in 2019. In 2023, NNDSS expanded to encompass all types of Carbapenemase-Producing Organism (CPOs) cases and included the addition of screening cases of *Candida auris*.

The DHSS Healthcare-Associated Infections/Antimicrobial Resistance (HAI/AR) Program is responsible for tracking both novel and targeted multidrug-resistant organisms (MDROs) as well as conducting epidemiological investigations of every reported case to obtain needed case information and provide infection control guidance to healthcare facilities. Additional resources for colonization screening efforts and Infection Control Assessment and Response (ICAR) site visits are also made available during each investigation outreach to help mitigate MDRO transmission within the healthcare facility. Since 2021, case reports have increased by more than 600% for CPOs and *Candida auris* within the state. Figure 1 below shows the cumulative totals of reported and investigated CPO and *Candida auris* cases received by the DHSS HAI/AR Program.

Figure 1: Carbapenemase-Producing Organisms and *Candida auris* Cases by Year (2021-2025)



2025 data does not include data from October 1st - December 31st

Preventing antimicrobial resistance and resistant infections requires an interdisciplinary approach to understand risk factors and exposures, to provide direct infection prevention and control guidance, and to ensure appropriate antibiotic use[2]. The HAI/AR Program works with healthcare providers, infection preventionists, pharmacists, and other types of healthcare personnel to strengthen infection prevention practices and antimicrobial stewardship in Missouri. The HAI/AR Program also works with the regulatory programs within DHSS to distribute provider education materials to healthcare facilities, especially long-term care facilities, as this is where numerous resistant infections and colonizations occur. Table 1 provides the demographic summaries for these cumulative reported/investigated CPO and Candida auris cases.

Table 1: Demographic Summaries of CPO and *Candida auris* Case Investigations (2021-2024)

Demographic Category		CPO No. (%)	C. auris* No. (%)
Age Group (Years)			
	0-14	15 (1.49%)	0 (0%)
	14-29	32 (3.17%)	7 (3.85%)
	30-44	97 (9.62%)	21 (11.54%)
	45-59	202 (20.04%)	37 (20.33%)
	60-74	409 (40.58%)	76 (41.76%)
	75-89	234 (23.21%)	38 (20.88%)
	90+	19 (1.88%)	3 (1.65%)
Sex			
	Male	597 (59.23%)	126 (69.23%)
	Female	411 (40.77%)	56 (30.77%)
Race			
	American Indian/Alaskan Native	1 (0.10%)	1 (0.55%)
	Asian	4 (0.40%)	0 (0%)
	Black/African American	79 (7.84%)	57 (31.32%)
	White	225 (22.32%)	111 (60.99%)
	Other	7 (0.69%)	0 (0%)
	Unknown	692 (68.65%)	13 (7.14%)
Ethnicity			
	Hispanic/Latino	6 (0.60%)	0 (0%)
	Not Hispanic/Latino	235 (23.31)	42 (23.08%)
	Unknown	776 (76.98)	140 (76.92%)
Public Health District			
	Central	54 (5.36%)	8 (4.40%)
	Eastern	408 (40.48%)	96 (52.75%)
	Northwest	277 (27.48%)	2 (1.10%)
	Southeast	61 (6.05%)	7 (3.85%)
	Southwest	80 (7.94%)	10 (5.49%)
	Out of State	128 (12.70%)	59 (32.42%)

**** Candida auris demographic summaries are from 2023-2024***

Candida auris

Candida auris is a newly emerging multidrug-resistant yeast that is spreading across the United States. The first in-state transmission in the state of Missouri was only detected in 2023. At baseline, *Candida auris* is already resistant to one out the three major antifungal drug classes used to treat these infections. Resistance to the two remaining antifungal drug classes is steadily increasing. Not only is antifungal resistance a concern for *Candida auris*, but it is also easily transmitted from person to person and can survive in healthcare environments for long periods of time. Adding to the challenge of tracking this organism and implementing infection prevention and control measures to slow or stop its spread, people can become colonized with *Candida auris* and carry it on their skin without any signs or symptoms that they have acquired the organism. This only increases their risk of getting a *Candida auris* infection as time continues.

Incidence/Type

Cases of *Candida auris* are split into two categories, clinical cases and screening cases. Case category definitions are provided below.

- Clinical case: Case identified from a microbiology specimen that was collected with the intent of influencing and/or directing treatment options and clinical management.
- Screening case: Case identified from a microbiology specimen that was collected solely for epidemiological surveillance purposes to assess potential organism colonization.

Table 2 provides a quarterly case count breakdown for Calendar Year 2025. Table 3 provides the *Candida auris* case breakdown between Case Types from 2021 to 2025.

Table 2: Quarterly *Candida auris* Case Count by Type (2025)*

	Clinical Cases	Screening Cases
January - March	21	80
April - June	29	62
July - September	41	199
October - December	*In Progress*	*In Progress*
Total *(Year-to-Date)*	**91**	**341**

Table 3: Annual *Candida auris* Case Count by Type (2021 – 2025)*

	2021	2022	2023	2024	2025**
Clinical Cases	2	0	4	42	91
Screening Cases	0	0	6	130	341
Total *C. auris* Cases	**2**	**0**	**10**	**172**	**432**

Case counts include Missouri residents identified at out of state healthcare facilities as well as out of state residents that were identified in Missouri healthcare facilities. This may create apparent discrepancies between data in this report and online CDC data. Also, a patient testing positive for Candida auris is generally counted as a single case (either "Clinical" or "Screening"). However, a patient may be counted twice if they were first identified as a "Screening Case" but then develops a clinical infection becoming a "Clinical Case".

****2025 data does not include data from October 1st - December 31st***

Distribution

Missouri's first evidence of local transmission of *Candida auris* was observed in October 2023 in the St. Louis Metro Area. Since that time, cases continue to be identified in new regions across Missouri. Cases of *Candida auris* are attributed to the jurisdiction of patient residence, in accordance with CDC and Council for State and Territorial Epidemiology (CSTE) communicable disease reporting guidance. Figure 2 below shows *Candida auris* clinical case counts by reported county of patient residence in 2025. Figure 3 shows *Candida auris* screening case counts by reported patient residence in 2025. The numbers in Figures 2 and 3 will not match Tables 2 and 3 because of the number of out of state residents that were identified in Missouri healthcare facilities; however, these are included in the tables to account for the program efforts on case investigations and providing guidance to facilities to minimize impact within Missouri.

Figure 2: Map of *Candida auris* Clinical Case Counts by Reported County of Patient Residence in 2025.

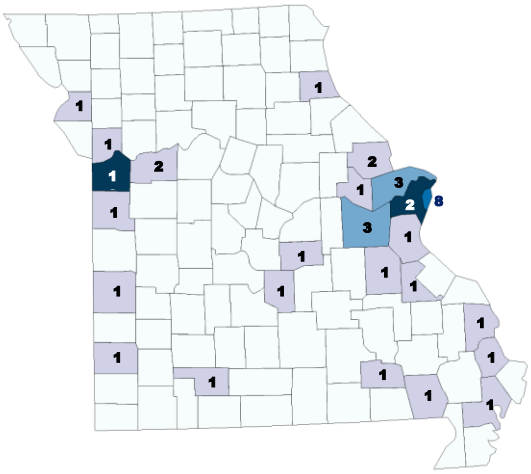
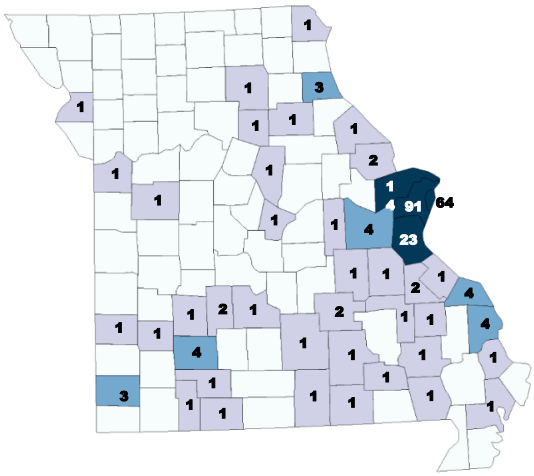


Figure 3: Map of *Candida auris* Screening Case Counts by Reported County of Patient Residence in 2025.



Carbapenemase-Producing Organisms (CPOs)

Carbapenem-Resistant Organisms (CROs) typically refer to a broad range of gram-negative bacteria that are resistant to the carbapenem class of antibiotics. Carbapenem antibiotics are one of the broadest classes of antibiotics currently available, meaning these antibiotics will kill a vast range of different bacteria, including the good bacteria that help maintain normal healthy body conditions. Carbapenem antibiotics are often referred to as “last line” antibiotics, being reserved for severe, life-threatening infections. Resistance to these antibiotics greatly affects patient outcomes, leading to increased

healthcare costs and the increased risk of death. Carbapenemase-Producing Organisms (CPOs) are a specialized subset of CROs that produce an enzyme (a carbapenemase) to breakdown carbapenem antibiotics, rendering them inactive. CPOs can transfer this carbapenem resistance through mobile genetic elements that are shared with other bacteria, even different species, which are adjacent to one another. This increases the rate of antimicrobial resistance transmission and spread, creating a challenge for healthcare and public health settings alike.

Incidence/Type

CPO cases are split into four categories based on the organism classification. These categories are listed below.

- **CP-CRAB**: Carbapenemase-Producing Carbapenem-Resistant *Acinetobacter baumannii*
- **CP-CRE**: Carbapenemase-Producing Carbapenem-Resistant Enterobacterales
- **CP-CRPA**: Carbapenemase-Producing Carbapenem-Resistant *Pseudomonas aeruginosa*
- **CP-Unknown**: Carbapenemase-Producing Unknown Organism

CPO case types ("Clinical" and "Screening") and case count determination follow the same guidance as *Candida auris* mentioned above. Below in Table 4, a breakdown of quarterly CPO case counts for Calendar Year 2025 is provided. Table 5 shows the trending CPO case count from 2021 to 2025.

Table 4: Quarterly CPO Case Counts by CPO Category (2025)*

	CP-CRAB	CP-CRE	CP-CRPA	CP-Unknown
January-March	57	36	2	0
April-June	62	55	4	4
July-September	57	45	4	1
October- December	*In Progress*	*In Progress*	*In Progress*	*In Progress*
Total	**176**	**136**	**10**	**5**

Table 5: Annual CPO Case Counts by CPO Category (2021 – 2025)*

	2021	2022	2023	2024	2025**
CP-CRE	63	66	148	142	136
CP-CRAB	48	73	183	244	176
CP-CRPA	2	3	7	4	10
CP-Unknown	7	2	5	11	5
Total	**120**	**144**	**343**	**401**	**327**

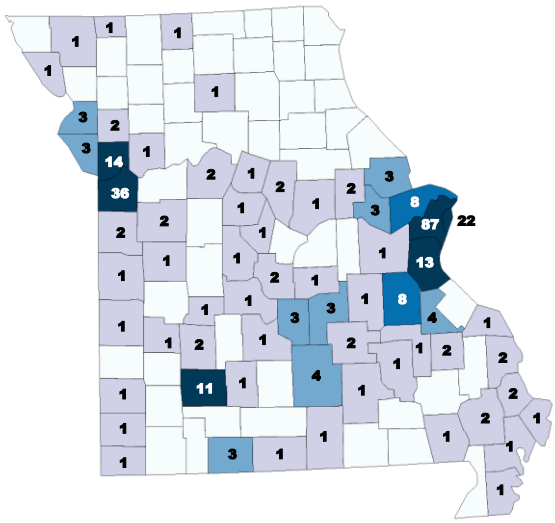
Case counts include Missouri residents identified at out of state healthcare facilities as well as out of state residents that were identified in Missouri Healthcare facilities. This may create apparent discrepancies between data in this report and online CDC data. Also, a patient testing positive for CPO is generally counted as a single case (either "Clinical" or "Screening"). However, a patient may be counted twice if they were first identified as a "Screening Case" but then develops a clinical infection becoming a "Clinical Case".

****2025 data does not include data from October 1st - December 31st***

Distribution

CPOs continue to be identified across multiple regions and counties within Missouri. Like *Candida auris*, CPO cases are attributed to the jurisdiction of patient residence in accordance with disease reporting guidance issued from CDC and CSTE. Figure 4 below shows CPO case counts by reported county of patient residence identified in 2025. As noted for Candida auris, the numbers in Figure 4 will not match Tables 4 and 5 because of the number of out of state residents that were identified in Missouri healthcare facilities.

Figure 4: Map of CPO Case Counts by Reported County of Patient Residence in 2025



MRSA, VRE, and CRE Reporting

Since 2004, aggregate counts of healthcare-associated, or nosocomial infections, Methicillin-resistant *Staphylococcus aureus* (HA-MRSA) and Vancomycin-resistant Enterococci (HA-VRE) have been a reporting requirement for hospitals and ambulatory surgical centers. These healthcare facilities report aggregate case counts on a quarterly basis. In 2018, healthcare-associated Carbapenem-Resistant Enterobacterales (HA-CRE) were added to this requirement by rule in 19 CSR 20-20.020. In 2025, 207 hospitals and ambulatory surgery centers have reported across Missouri. Table 6 provides a geographical breakdown by public health district for HA-MRSA, HA-VRE, and HA-CRE. Table 7 provides reported aggregated for HA-MRSA, HA-VRE, and HA-CRE for Calendar Year 2025. Table 8 shows the reported aggregate total by year, starting in 2021.

Table 6: Reported Counts of HA-MRSA, HA-VRE, and HA-CRE by Public Health District (2025)*

Public Health District	HA-MRSA	HA-VRE	HA-CRE
Central	68	89	23
Eastern	387	69	330
Northwest	195	103	98
Southeast	32	14	42
Southwest	50	21	26
Total	**732**	**296**	**519**

Table 7: Reported Counts of HA-MRSA, HA-VRE, and HA-CRE by Quarter (2025)*

	HA-MRSA	HA-VRE	HA-CRE
January - March	239	92	204
April - June	280	143	156
July - September	213	61	159
October - December	*In Progress*	*In Progress*	*In Progress*
Total	**732**	**296**	**519**

Table 8: Annual Reported Counts of HA-MRSA, HA-VRE, and HA-CRE (2021 – 2025)*

	2021	2022	2023	2024	2025*
HA-MRSA	525	1078	782	975	732
HA-VRE	101	360	209	252	296
HA-CRE	441	581	532	716	519
Total	**1067**	**2019**	**1523**	**1943**	**1547**

2025 data does not include data from October 1st - December 31st

Missouri State Public Health Laboratory Testing

Missouri State Public Health Laboratory (MSPHL) performs testing for MDROs that is essential in HAI/AR Program investigation and outreach efforts. This includes identifying common genes that are associated with CPOs and whole genome sequencing (WGS) to identify new gene variants and for outbreak response. Without testing performed by MSPHL, the HAI/AR Program would not be notified of many of these cases from healthcare facilities. Also, MSPHL serves as a method of confirmation testing since there are many clinical microbiology laboratories that lack this capacity. MSPHL testing ensures that all healthcare facilities in Missouri have access to testing. See Table 9 below for number of CRO tests performed by MSPHL for Calendar Year 2025.

Table 9: CRO Testing Performed by MSPHL (2025)

Test Type	Number of Test Performed*
Organism Identification	951
mCIM	711
PCR	414
WGS	353

Data as of November 21, 2025. In this protocol, MSPHL performs a modified Carbapenem Inactivation Method (mCIM) test on specimens meeting testing criteria. Isolates that have a positive mCIM result are then tested for specific carbapenemase resistance genes through polymerase chain reaction (PCR). Acinetobacter species are not tested with mCIM, in accordance with national standardize guidance.

MSPHL is anticipated to begin identification and WGS for *Candida auris* in early 2026. Currently, these specimens are forwarded to the Minnesota Department of Health State Public Health Laboratory through the Antimicrobial Resistance Laboratory Network (ARLN). Colonization screening resources for CPOs and *Candida auris* are available in conjunction with our ARLN laboratory partner.

Additional DHSS HAI/AR Program Efforts

Some HAI/AR Program successes for the 2025 calendar year include:

- Investigating a total of 1,029 reports of CPOs and *Candida auris* between January 1st and September 30th, 2025, nearly doubling the 2024 investigations total
- Submitting two HAI outbreak response effort abstracts for the 2026 CSTE Conference
- Participating in a national CSTE peer-to-peer visit effort to foster increased multi-jurisdictional collaboration between neighboring state and local health department HAI/AR Programs
- Co-facilitating a virtual antimicrobial stewardship conference hosted by CSTE for public health workers across the nation
- Collaborating with multi-jurisdictional HAI/AR Programs to publish a review of the top 11 publications deemed to be core to understanding public health antimicrobial stewardship across a variety of healthcare settings
- Collaborating with a major academic medical center in Missouri to submit an article reviewing outpatient antibiotic prescribing within Missouri for publication
- Facilitating, either directly or through contracted support, an ICAR in over 45% of licensed long-term care facilities within Missouri

Infection Control Assessment and Response

In addition to successes listed above, the HAI/AR Program continues to offer ICAR visits to collaboratively discuss and observe infection prevention and control practices within healthcare facilities across the state of Missouri. For each visit, the HAI/AR Program provides recommendations for any noted opportunities for improvements as well as acknowledging strengths of healthcare facility Infection Prevention (IP) Programs. These ICAR visits can be either virtual or in-person and are requested by healthcare facilities either in response to the detection of a novel MDRO, as part of a healthcare-associated infection outbreak at a healthcare facility, or as a preventative assessment as part of a continuous improvement opportunity within the healthcare facility's IP Program. ICAR visits are offered free of charge to any interested healthcare facility.

Due to the completion of a federally funded contract with a local academic medical partner's School of Nursing, external assistance with ICAR coverage in long-term care facilities (LTCFs) ended on July 31, 2025. The previous contract focused on conducting proactive ICARs in LTCFs as these facilities tend to be more under-resourced for infection prevention than other facility types yet house a high-risk population for acquiring these organisms. Since the contract and the associated supplemental federal funding ended, the HAI/AR Program has accommodated all requested ICARs to date, conducting an ICAR at each facility that expresses interest. Table 10 below showcases the total number of ICARs conducted.

Table 10: Number of ICARs Conducted by Facility Type and Year (2023 – 2025)

Healthcare Facility Type	2023	2024	2025*
Long Term Care Facilities**	258	225	109
Long Term Acute Care Hospitals	1	0	1
Acute Care Hospitals	1	3	0
Dialysis Facilities	0	1	0
Other Healthcare Facilities	0	0	1
Total	**260**	**229**	**111**

2025 Data does not include data from October 1st -December 31st
****** LTCF ICARs between January 1, 2023, and July 31, 2025, were completed by contracted support***

Antimicrobial Stewardship

Antimicrobial stewardship is the principle and practice of ensuring optimal antimicrobial medication use. Antimicrobial stewardship centers around the "5 Ds": Diagnosis, Drug, Dose, Duration, and De-escalation. Inappropriate antimicrobial use is often cited as prescribing an ineffective drug, a dose that does not properly treat the infection, and/or a duration that is either too short or too long to treat the infection. CDC reports show that approximately 30-50% of all antibiotics used in hospitals are deemed inappropriate based on concordance with national guidance[7]. Similarly, antibiotics used in long-term care settings have been deemed inappropriate in 40-75% of antibiotic orders[7]. Outpatient antibiotic use also sees a significant portion of inappropriate antibiotic use, with 30% of antibiotic prescriptions being deemed inappropriate[7]. Antimicrobial stewardship is a key driver in preventing antimicrobial resistance infections because inappropriate antibiotic use applies selective pressure favoring antimicrobial resistant organisms. That happens as highly drug susceptible organisms are killed off by the antibiotic, leaving the resistant organisms behind to multiply and take over.

Core Elements of Antimicrobial Stewardship

In 2014, the CDC established "7 Core Elements of Antibiotic Stewardship" as a key framework to address optimal antimicrobial use in acute care hospitals. Since that time, Core Elements have been created for nursing homes, outpatient, and resource-limited settings. The 7 Core Elements focus on 1) leadership commitment, 2) program accountability, 3) drug expertise, 4) action, 5) tracking, 6) reporting, and 7) education. The high number of Core Elements met, the more established and effective a facility's Antimicrobial Stewardship Program is thought to be. Facilities that report into the National Healthcare Safety Network (NHSN) are able to self-report their implementation of these elements annually as part of the Annual Patient Safety Survey within NHSN. Figure 5 below provides the cumulative percentage of

both acute care and long-term care facilities self-reporting that they met all 7 Core Elements of Antimicrobial Stewardship. Figure 6 and Figure 7 display the individual Core Elements met by acute care hospitals and long-term care settings compared to the national average.

Figure 5: Percentage of All 7 Core Elements of Antimicrobial Stewardship Met

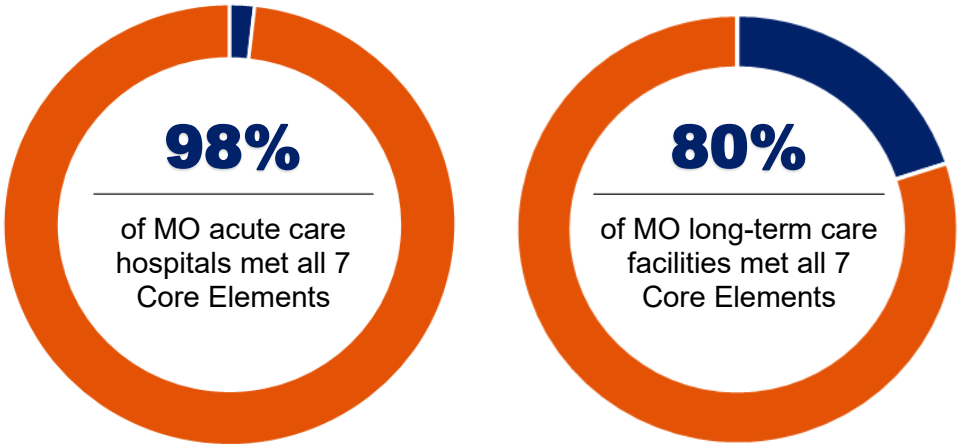


Figure 6: Percentage of Core Elements Met by Reporting Acute Care Hospitals

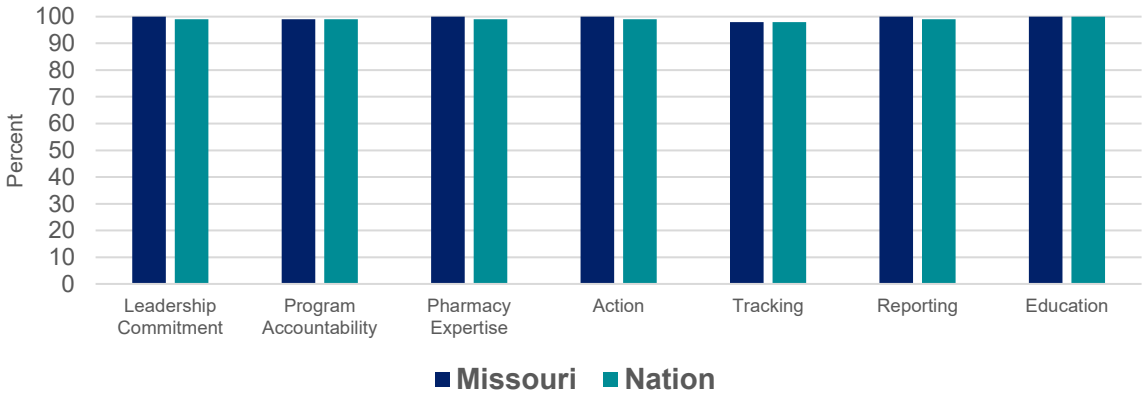
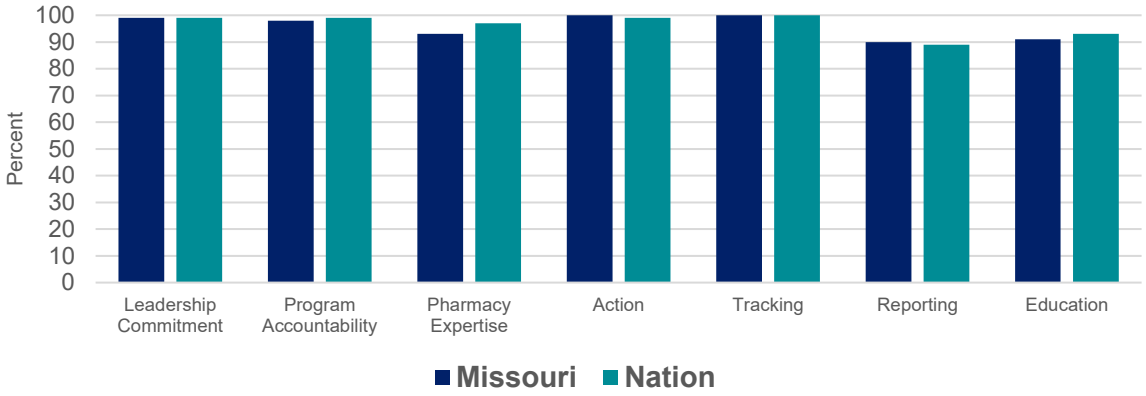


Figure 7: Percentage of Core Elements Met by Reporting Long-Term Care Facilities



Outbreak Investigation: Safe Injection Practices

The HAI/AR Program led an outbreak investigation of *Klebsiella aerogenes* following intraarticular (joint) pain injections after receiving reports of multiple patients who had received these injections from the same outpatient pain clinic. Upon investigation, patients received injections of the same medications at this clinic within a 2-week timeframe. In collaboration with the clinic and overseeing medical provider, a ICAR site visit was conducted. Key opportunities for improvement addressed during the ICAR including safe injection practices, such as proper medication storage, preparation, and administration, and other infection prevention and control practices that included re-emphasizing appropriate cleaning and disinfection practices of the healthcare/patient care environment and the importance of performing a risk-assessment in the event of clinic, or building, construction and renovation. With this collaborative effort, the clinic was able to make practice adjustments that continued to ensure patient safety and positive outcomes in the medical care provided.

Data Modernization

DHSS has completed its onboarding of a new disease surveillance system called ShowMe World Care. With this new implementation, the HAI/AR Program was able to participate and add CPOs and *Candida auris* as available conditions to monitor and report within this system. The new system allows for electronic laboratory reporting from clinical microbiology laboratories from hospitals across the state to automatically populate into the system. This allows the HAI/AR Program to receive reports of CPOs and/or *Candida auris* is a more timely manner, which decreases the time to facility outreach to ensure appropriate infection prevention and control measures are being used with associated cases. This system also allows the information collected during CPO and *Candida auris* investigations to be evaluated for actionable measures, including outbreak detection, in a more systematic method, compared to previous manual, time intensive efforts.

Increased Colonization Screening Efforts

Colonization screening is an infection prevention surveillance method to identify possible individuals that may be colonized, or an asymptomatic carrier, of a MDRO before they become infected. This allows a healthcare facility to implement appropriate infection prevention and control measures, as a colonized

patient can still transmit a MDRO. Colonization screening can be performed for both CPOs and *Candida auris.* As *Candida auris* was introduced and subsequently started spreading across the state, the HAI/AR Program was able to collaborate with two of the largest healthcare systems in Missouri to initiate thorough colonization screening protocols and processes to match their distinct patient populations and internal clinical microbiology laboratory capacities. Because of the implementation of these internal colonization screening efforts, these facilities are able identify individuals that are deemed high-risk of acquiring *Candida auris* due to individual risk factors and possible exposures to known *Candida auris* cases. This effort also reduces laboratory sample transit times to the ARLN laboratory partner, facilitating quicker times to start appropriate infection prevention and control measures to ensure ongoing patient safety and to help curb further spread of *Candida auris* within the healthcare facility and community.

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