West Virginia Department of Health

Division of Healthcare Quality Promotion, Prevention & Response

Multidrug-Resistant Organisms

2025 Surveillance Report

West Virginia Department of HEALTH

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Multidrug-Resistant Organisms 2025 Surveillance Report
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Background

Multidrug-Resistant Organisms (MDRO) are responsible for a growing number of infections in healthcare settings in West Virginia and across the country. Carbapenem-Resistant Organisms (CRO) are a type of bacterial MDRO that can result in asymptomatic colonization or active infection, particularly in healthcare settings. They are difficult to treat and are included in the Centers for Disease Control's (CDC) Antimicrobial Resistance Threats in the United States, 2021-2022. These organisms can cause a wide range of infections, and have developed resistance to a last-line antibiotic class: the carbapenems. These include imipenem, meropenem, and ertapenem. Bacteria in the taxonomic order called Enterobacterales (CRE), and others like Carbapenem Resistant *Acinetobacter baumannii* (CRAB) in the *Moraxellaceae* family and Carbapenem Resistant *Pseudomonas aeruginosa* (CRPA) in the *Pseudomonadaceae* family, are commonly found in the environment and can cause the same types of infections. They are associated with high mortality rates depending on the type of bacteria.

Carbapenemase-Producing Organisms (CPO) are those that have acquired mobile genetic elements, also known as plasmids, that carry genes with the ability to produce enzymes that actively hydrolyze or break down carbapenem antibiotics. These plasmids are easily exchanged between different bacteria, thus facilitating the rapid spread of carbapenem resistance. *Klebsiella pneumoniae* carbapenemase (KPC) is most common in the United States, followed by New Delhi Metallo-β-lactamase (NDM), and oxacillinase-like carbapenemase-(OXA-like) producing infections. Through collaboration with the Antimicrobial Resistance Laboratory Network (ARLN), and the whole genome sequence (WGS) testing support they provide, we are able to detect more CPOs and CPO subtypes, expanding our ability to more rapidly and precisely detect and track disease patterns.

Consistent with national trends, KPC was the most prevalent carbapenemase type in West Virginia in 2025. Despite this, its share of total annual cases continues to drop, moving from 54% of CPO cases in 2024 to 51% in 2025. The second most common type detected was OXA-like. Numerous subvariants exist within this group, including OXA-23, OXA-24, OXA-48, and OXA-66, among others. Among the forty patients (39%) exhibiting OXA-like enzymes, OXA-23 constituted the largest number, with 21 occurrences. A small subset of patients presented with both KPC and OXA-like enzymes or others. NDM cases represented 14% of the total enzymes detected, nearly doubling the 8% reported in 2024.

Candidozyma auris (*C. auris*) is a type of yeast that can cause severe illness and sometimes death due to its efficient resistance to antifungal medications and ability to persist in the environment. Since its 2009 discovery in Japan, *C. auris* has spread globally. The first case in West Virginia occurred in 2023. In 2025, there were 15 cases. Two of those were found during screening, and the remainder were clinical cases. We believe this number is low due to testing constraints and reporting gaps. We continue to support testing and to educate providers, facilities, and laboratories about the West Virginia Reportable Disease Rule requirements to report.

Methods

For 2025 surveillance purposes, a case of CRO was defined as organisms resistant to one or more carbapenem antibiotics. There were four exceptions to this case definition: *Proteus* spp., *Providencia* spp., *Morganella* spp., and *Stenotrophomonas* spp. These organisms are intrinsically resistant to imipenem and must be resistant to one carbapenem other than imipenem OR be a documented carbapenemase producer. CRAB was defined as carbapenem-resistant if demonstrating a minimum inhibitory concentration (MIC) rate of ≥8µ/ml for imipenem or meropenem. *Pseudomonas aeruginosa* met case definition criteria if MIC values for imipenem or meropenem were ≥8µ/ml AND non-susceptibility to cefepime or ceftazidime was demonstrated with a MIC value of ≥16µ/ml OR if resistance to ceftolozane/tazobactam with a MIC value of ≥16/4µ/ml was detected.

Case counts were based on the date of the laboratory report. Each case was stratified by whether the specimen was clinical versus screening, and by the detection of a specific carbapenemase gene(s) when known. A specific organism/carbapenemase combination in the same person was counted as a separate case from other organism/carbapenemase combinations in the same person. A person classified as a clinical case was not counted as a screening case thereafter for the same organism/carbapenemase combination. A person classified as a screening case could be later counted as a clinical case with the same organism/carbapenemase combination. This was the only way that the same organism/carbapenemase combination could be counted twice for the same person. Finally, a case with a known carbapenemase but an unknown organism was only counted once for that carbapenemase.

Limitations

Data interpretation must account for several limitations. Of 244 cases in 2025, 42% (102) were CPOs, while 16% (38) tested negative for carbapenemase production. However, 28 cases were not tested and 76 remain unknown, suggesting nearly half of all cases could be CPO positive. Definitive confirmation is hindered by limited laboratory resources and equipment for carbapenemase testing, which is essential for targeted infection prevention and rapid investigations.

While the West Virginia HAI/AR Program, OLS, and ARLN provide testing access, increasing program enrollment and awareness remains challenging. Similarly, *C. auris* detection is complicated by frequent misidentification, a lack of specialized laboratory equipment, and limited experience among laboratorians.

Data quality is further affected by reliance on LHD case investigations, which face obstacles like recall bias, interview refusals, and difficulties contacting patients. Furthermore, omissions or delays in entering data—such as specimen source, testing status, and public health actions—into WVEDSS impact the accuracy of surveillance.

Risk Factors

Risk factors for MDRO infection can be categorized into clinical, demographic, and environmental categories. Major clinical risk factors include exposure to healthcare and hospitalization, particularly in long-term acute care (LTAC) and long-term care facilities (LTCs); being prescribed antimicrobial medications more than two times in the six months prior to diagnosis; presence of medical devices such as urinary catheters, central venous lines and mechanical ventilation during the two days prior to specimen collection; and previous colonization with an MDRO. Older people (typically 65+) with underlying health conditions like chronic diseases, those who are immunocompromised and anyone with wounds are at high risk.

Completeness

Overall, completeness of case investigations in WVEDSS remains a limitation. Enhanced surveillance of MDROs is needed to provide a more accurate estimate of disease burden. The following table defines and illustrates statewide completeness for 2025.

Table 11. Completeness Data Statewide.

Completeness Data Statewide		
	Completed	**N**
Element		
Organism Name	258 (99.6%)	259
Specimen Source	252 (97.3%)	259
Culture Type	253 (97.7%)	259
*Tested for Carbapenemase Production	140 (57.1%)	245
**Mechanism/Test Type	99 (97.1%)	102
Hospitalized?	171 (66.0%)	259
Antimicrobials >2X in the last 6 months?	122 (47.1%)	259
Indwelling devices?	121 (46.7%)	259
Resident of NH or LTC facility?	92 35.5%)	259
***Did the LTC receive education?	71 (77.2%)	92
Did the patient/caregiver receive education?	120 (46.3%)	259

* *C. auris* isolates are not tested for carbapenemase production.

** Mechanism/Test Type "N" differs from total because not all isolates were tested for mechanism/test type.

*** "Did the LTC receive education?" "N" differs from total because only residents of LTCs were included.

Results

CRO and CPO

In 2025, the most frequently reported CROs identified were *Acinetobacter baumannii* (40 cases, 28.2%), *Pseudomonas aeruginosa* (45 cases, 31.7%), *Klebsiella pneumoniae* (22 cases, 15.5%), *Enterobacter cloacae complex* (18 cases, 12.7%), and *Escherichia coli* (seven cases, 4.9%). The remaining 10 cases comprised other organism types. Similarly, Carbapenemase-Producing Organism (CPO) cases totaled 102 and consisted of *Acinetobacter baumannii* (36 cases, 35.3%), *Pseudomonas aeruginosa* (one case, 1.0%), *Klebsiella pneumoniae* (36 cases, 35.3%), *Enterobacter cloacae complex* (10 cases, 9.8%), and *Escherichia coli* (six cases, 5.9%). An additional thirteen cases were attributed to other organisms.

A further delineation of CRO and CPO cases according to surveillance region is outlined in the following table and figure:

Table 1. CRO cases (N=142) by surveillance region by organism, culture type & specimen source.

CRO Cases by Surveillance Region							
	Northern (N=8)	**Northeast-ern (N=17)**	**Eastern (N=13)**	**Southern (N=39)**	**Central (N=20)**	**Western (N=33)**	**Mid-Ohio Valley (N=11)**
Organism Cultured							
Acinetobacter baumannii	2 (25.0%)	2 (11.8%)	0	17 (43.6%)	4 (20.0%)	12 (36.4%)	3 (27.3%)
Pseudomonas aeruginosa	4 (50.0%)	4 (23.5%)	5 (38.0%)	9 (23.1%)	7 (35.0%)	11 (33.3%)	4 (36.4%)
Klebsiella pneumoniae	2 (25.0%)	3 (17.6%)	2 (15.4%)	6 (15.5%)	5 (25.0%)	4 (12.1%)	0
Enterobacter cloacae complex	0	4 (23.5%)	4 (30.7%)	4 (10.3%)	2 (10.0%)	1 (3.0%)	3 (27.3%)
Escherichia coli	0	2 (11.8%)	2 (15.4%)	0	2 (10.0%)	0	1 (9.1%)
Other/Unknown	0	2 (12.0%)	0	3 (7.7%)	0	16 (48.5%)	0
Type of Culture							
Clinical	7 (87.5%	17 (100%)	13 (100%)	39 (100%)	30 (91.0%)	30 (91.0%)	9 (81.8%)
Specimen Source							
Urine	3 (37.5%)	11 (64.7%)	11 (84.6%)	18 (46.2%)	11 (55.0%)	12 (36.4%)	5 (45.5%)
Respiratory	1 (12.5%)	5 (29.4%)	1 (7.7%)	9 (23.1%)	4 (20.0%)	9 (27.3%)	0
Wound	2 (25.0%)	0	1 (7.7%)	6 (15.5%)	3 (15.0%)	9 (27.3%)	4 (36.4%)
Blood	0	1 (5.9%)	0	1 (2.6%)	2 (10.0%)	0	1 (9.1%)
Other/Unknown	2 (25.0%)	0	0	5 (12.8%)	0	3 (9.1%)	1 (9.1%)

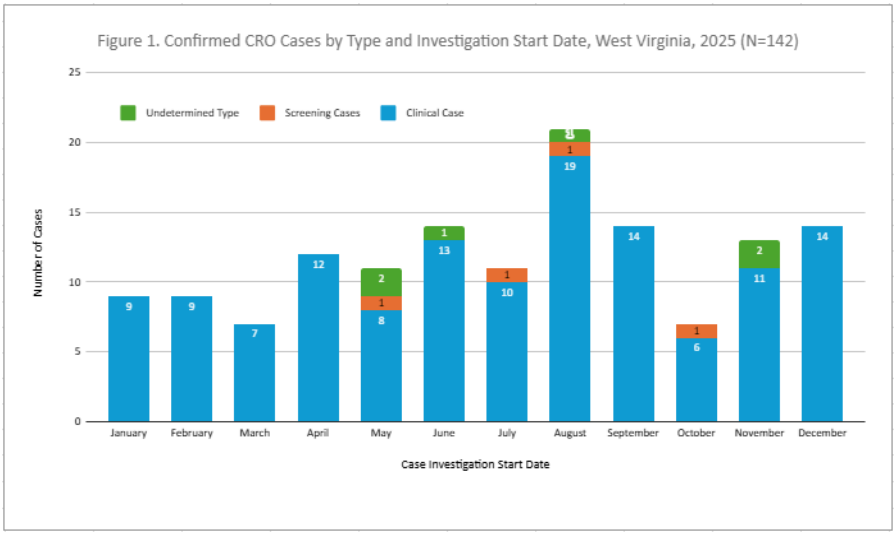

Figure 1. Epidemic curve of confirmed screening & clinical CRO cases according to investigation start date (N=142).

Table 2. CPO cases (N=102) by surveillance region by organism, culture type, & specimen source.

CPO Cases by Surveillance Region							
	Northern (N=5)	**Northeast-ern (N=8)**	**Eastern (N=9)**	**Southern (N=47)**	**Central (N=16)**	**Western (N=11)**	**Mid-Ohio Valley (N=6)**
Organism Cultured							
Acinetobacter baumannii	0	2 (25.0%)	1 (11.1%)	21 (44.7%)	4 (25.0%)	8 (72.8%)	0
Pseudomonas aeruginosa	1 (20%)	0	0	0	0	0	0
Klebsiella pneumoniae	2 (40.0%)	4 (50.0%)	1 (11.1%)	18 (38.3%)	8 (50.0%)	2 (18.2%)	1 (16.7%)
Enterobacter cloacae complex	1 (20%)	0	0	5 (10.6%)	1 (6.25%)	1 (9.1%)	2 (33.3%)
Escherichia coli	0	1 (12.5%)	2 (22.2%)	1 (2.1%)	1 (6.25%)	0	1 (16.7%)
Other/Unknown	0	1 (12.5%)	5 (55.6%)	2 (4.3%)	2 (12.5%)	0	2 (33.3%)
Type of Culture							
Clinical	5 (100%)	8 (100%)	9 (100%)	40 (85.1%)	16 (100%)	11 (100%)	6 (100%)
Specimen Source							
Urine	3 (60.0%)	4 (50.0%)	7 (77.8%)	14 (29.8%)	4 (25.0%)	4 (36.4%)	4 (66.7%)
Respiratory	2 (40.0%)	2 (25.0%)	0	14 (29.8%)	11 (68.8%)	4 (36.4%)	1 (16.7%)
Wound	0	1 (12.5%)	0	7 (14.9%)	0	1 (9.1%)	0
Blood	0	0	0	2 (4.3%)	0	1 (9.1%)	0
Other/Unknown	0	1 (12.2%)	2 (22.2%)	10 (21.3%)	1 (6.25%)	1 (9.1%)	1 (16.7%)

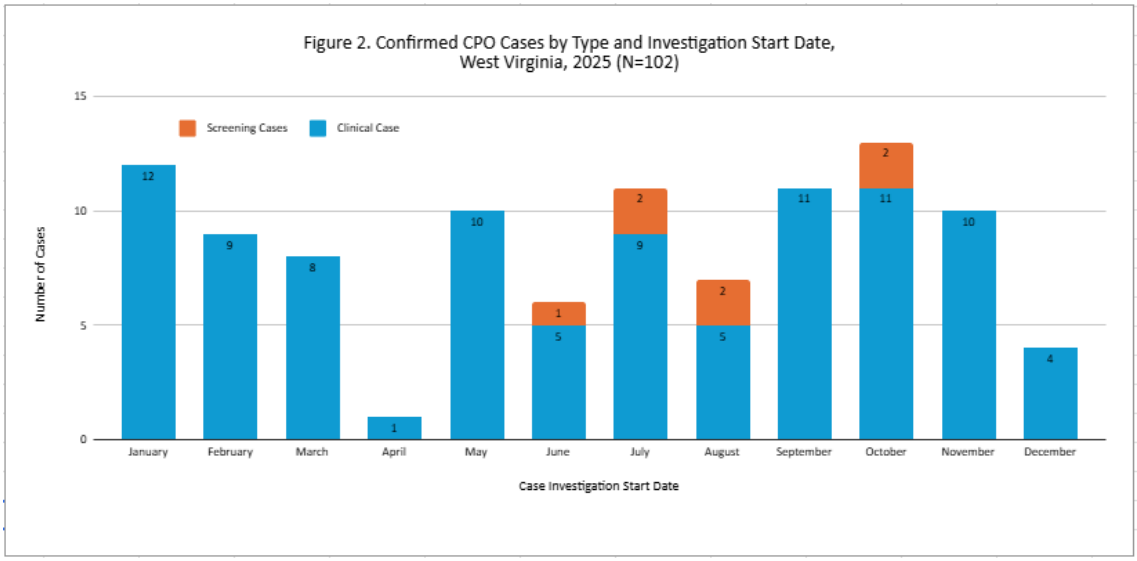

Figure 2.Epidemic curve of confirmed screening & clinical CPO cases according to investigation start date (N=102).

C. auris in West Virginia

In 2025, there were 15 total cases of *C. auris*, encompassing both clinical and screening detections. All seven surveillance regions reported at least one case. Five of these cases were detected in healthcare facilities located outside of West Virginia. All cases originated in acute care settings. The majority of patients were male (11), with the remaining four being female. Patient ages ranged from 37 to 86 years. Whole Genome Sequencing (WGS) analysis, performed by our ARLN partner on select isolates forwarded by OLS, identified three as clade one and three as clade three.

C. auris clades are recognized as distinct, geographically clustered, and genetically divergent lineages of this multidrug-resistant yeast, with six main clades (I–VI) identified globally: South Asian (I), East Asian (II), African (III), South American (IV), Iranian (V), and Indomalayan (VI). These clades exhibit distinct resistance profiles. Clades I, III, and IV are most frequently associated with invasive outbreaks, while clade II typically causes ear infections. Clade I (South Asian) demonstrates a high prevalence, with widespread reports in India, Pakistan, the UK, and the US. Clade III (African) has been identified in South Africa, the UK, and North America.

Determining the clade (genomic lineage) of a *C. auris* isolate is primarily critical for public health tracking, outbreak management, and research purposes, rather than for immediate, individual bedside treatment decisions. While clade identification is not typically utilized for selecting an antimicrobial agent for an individual patient at the exact moment of care, it furnishes essential information for hospital epidemiologists and public health officials to mitigate the spread of this "superbug."
Because of the low numbers of *C. auris* reported, they are not reported per surveillance region in this report.

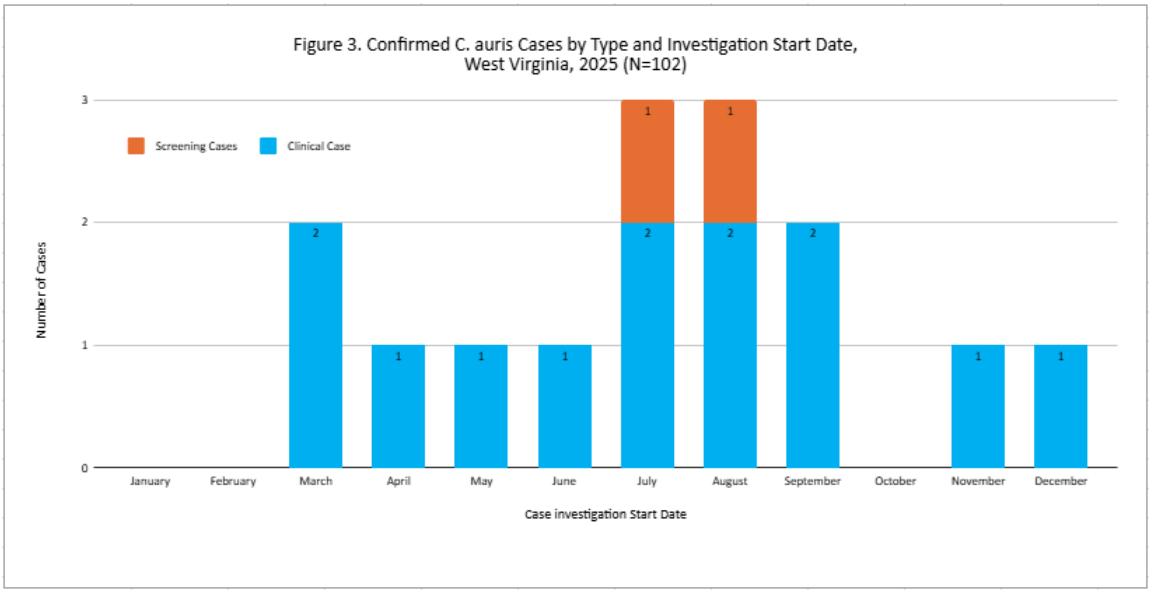

Figure 3. Epidemic curve of screening & clinical cases of *C. auris* cases according to investigation start date (N=15).

MDROs by Surveillance Region

Northern Region

In the Northern Region, there were a total of eight CRO cases and five CPO cases reported. The most frequent organism cultured in the CRO cases was *Pseudomonas aeruginosa* at 50.0% (four cases), followed by *Acinetobacter baumannii* and *Klebsiella pneumoniae*, each accounting for 25.0% (two cases). For CPO cases, *Klebsiella pneumoniae* was the most common organism at 40.0% (two cases). *Pseudomonas aeruginosa*, *Enterobacter cloacae complex*, and 'Other' organisms each accounted for 20.0% (one case) of the CPO cases. There were no CRO or CPO cases associated with *Escherichia coli*.

Table 4. CRO (N=8) & CPO (N=5) cases in the northern surveillance region.

CRO & CPO Cases, Northern Region		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	2 (25.0%)	0
Pseudomonas aeruginosa	4 (50.0%)	1 (20.0%)
Klebsiella pneumoniae	2 (25.0%)	2 (40.0%)
Enterobacter cloacae complex	0	1 (20.0%)
Escherichia coli	0	0
Other	0	1 (20.0%)

Northeastern Region

In the Northeastern Region, a total of 17 CRO cases and eight CPO cases were reported. For CRO cases, *Pseudomonas aeruginosa* accounted for the largest percentage at 23.5% (four cases), followed by *Enterobacter cloacae complex* at 23.5% (four cases), *Klebsiella pneumoniae* at 17.6% (three cases), and *Acinetobacter baumannii*, *Escherichia coli*, and *Other* organisms each representing 11.8% (two cases). In contrast, CPO cases were predominantly due to *Klebsiella pneumoniae* at 50.0% (four cases). *Acinetobacter baumannii* made up 25.0% (two cases) of CPO cases, and *Escherichia coli* and *Other* organisms each accounted for 12.0% (one case). There were no CPO cases reported for *Pseudomonas aeruginosa* or *Enterobacter cloacae complex*.

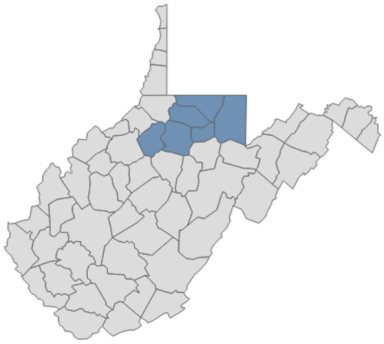

Table 4. CRO (N=8) & CPO (N=5) cases in the northeastern surveillance region.

CRO & CPO Cases, Northern Region		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	2 (25.0%)	0
Pseudomonas aeruginosa	4 (50.0%)	1 (20.0%)
Klebsiella pneumoniae	2 (25.0%)	2 (40.0%)
Enterobacter cloacae complex	0	1 (20.0%)
Escherichia coli	0	0
Other	0	1 (20.0%)

Eastern Region

In the Eastern Region, there were a total of 13 CRO cases and nine CPO cases identified. Of the CRO cases, *Pseudomonas aeruginosa* was the most common organism cultured, accounting for five cases (38.5%), followed by *Enterobacter cloacae complex* with four cases (30.8%). Both *Klebsiella pneumoniae* and *Escherichia coli* each accounted for two cases (15.4%). For the CPO cases, five cases (55.6%) were classified as "Other" organisms. *Escherichia coli* was the next most frequent, with two cases (22.2%), while *Acinetobacter baumannii* and *Klebsiella pneumoniae* each accounted for one case (11.1%).

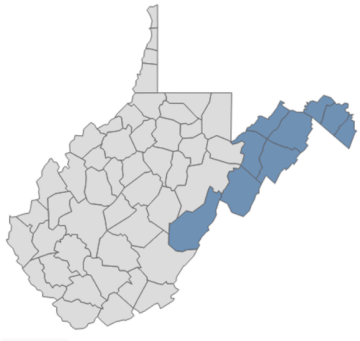

Table 6. CRO (N=13) & CPO (N=9) cases in the Eastern surveillance region.

CRO & CPO Cases, Eastern Region		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	0	1 (11.1%)
Pseudomonas aeruginosa	5 (38.5%)	0
Klebsiella pneumoniae	2 (15.4%)	1 (11.1%)
Enterobacter cloacae complex	4 (30.8%)	0
Escherichia coli	2 (15.4%)	2 (22.2%)
Other	0	5 (55.6%)

Southern Region

In the Southern Region, *Acinetobacter baumannii* was the most frequently cultured organism in both CRO and CPO cases, accounting for 17 (43.6%) of CRO cases and 21 (44.7%) of CPO cases. For CRO cases, *Pseudomonas aeruginosa* was the next most common at nine (23.1%), followed by *Klebsiella pneumoniae* at six (15.4%) and *Enterobacter cloacae complex* at four (10.3%). Three CRO cases (7.7%) were attributed to "Other" organisms, with no *Escherichia coli* CRO cases reported. For CPO cases, *Klebsiella pneumoniae* was the second most common organism at 18 (38.3%), followed by *Enterobacter cloacae complex* at five (10.6%). *Escherichia coli* accounted for one (2.1%) of CPO cases, and "Other" organisms accounted for two (4.3%). Notably, no *Pseudomonas aeruginosa* CPO cases were reported.

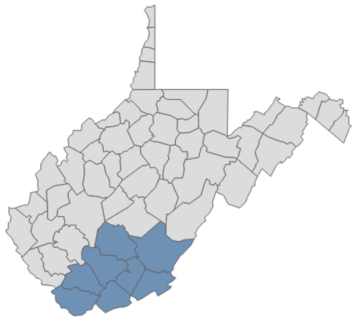

Table 7. CRO (N=39) & CPO (N=47) cases in the Southern surveillance region.

CRO & CPO Cases, Southern Region		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	17 (43.6%)	21 (44.7%)
Pseudomonas aeruginosa	9 (23.1%)	0
Klebsiella pneumoniae	6 (15.4%)	18 (38.3%)
Enterobacter cloacae complex	4 (10.3%)	5 (10.6%)
Escherichia coli	0	1 (2.1%)
Other	3 (7.7%)	2 (4.3%)

Central Region

In the Central region's reporting for CRO and CPO, *Pseudomonas aeruginosa* was the most frequently cultured organism in CRO cases, accounting for seven (35.0%) of the cases, followed closely by *Klebsiella pneumoniae* with five (25.0%). Both *Acinetobacter baumannii*, *Enterobacter cloacae complex*, and *Escherichia coli* each accounted for two (10.0%) of the CRO cases. Conversely, *Klebsiella pneumoniae* was the most common CPO organism, representing eight (50.0%) of the cases, while *Acinetobacter baumannii* accounted for four (25.0%). Other organisms comprised two (13.0%) of the CPO cases, and *Enterobacter cloacae complex* and *Escherichia coli* each made up one (6.0%) of the CPO cases. Notably, *Pseudomonas aeruginosa* was only found in CRO cases and not in any CPO cases reported in the Central region.

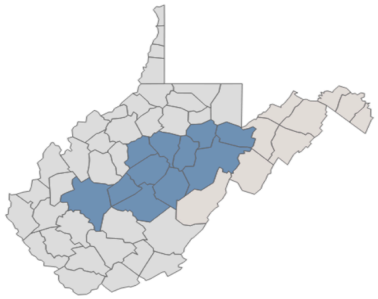

Table 8. CRO (N=20) & CPO (N=16) cases in the Central surveillance region.

CRO & CPO Cases, Central		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	4 (20.0%)	4 (25.0%)
Pseudomonas aeruginosa	7 (35.0%)	0
Klebsiella pneumoniae	5 (25.0%)	8 (50.0%)
Enterobacter cloacae complex	2 (10.0%)	1 (6.0%)
Escherichia coli	2 (10.0%)	1 (6.0%)
Other	0	2 (13.0%)

Western Region

In the Western region, *Acinetobacter baumannii* accounted for the largest proportion of both CRO and CPO cases, making up 36.4% (12 cases) of CRO and 72.7% (eight cases) of CPO. *Pseudomonas aeruginosa* was the second most common organism for CRO cases at 33.3% (11 cases), but was not isolated in any CPO cases. *Klebsiella pneumoniae* contributed to 12.1% (four cases) of CRO and 18.2% (two cases) of CPO. *Enterobacter cloacae complex* represented 3.0% (one case) of CRO and 9.1% (one case) of CPO. *Escherichia coli* was not cultured in any cases. Finally, 'Other' organisms accounted for 15.2% (five cases) of the Western region's CRO cases.

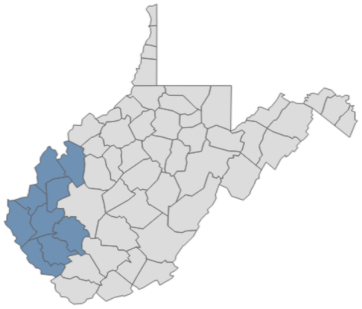

Table 9. CRO (N=33) & CPO (N=11) cases in the Western surveillance region.

CRO & CPO Cases, Western		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	12 (36.4%)	8 (72.7%)
Pseudomonas aeruginosa	11 (33.3%)	0
Klebsiella pneumoniae	4 (12.1%)	2 (18.2%)
Enterobacter cloacae complex	1 (3.0%)	1 (9.1%)
Escherichia coli	0	0
Other	5 (15.2%)	0

Mid-Ohio Valley Region

In the Mid-Ohio Valley, a total of 11 CRO cases and six CPO cases were reported. Among the CRO cases, *Pseudomonas aeruginosa* was the most frequently cultured organism, accounting for four cases (36.4%), followed by both *Acinetobacter baumannii* and *Enterobacter cloacae complex*, each with three cases (27.3%). A single case of *Escherichia coli* (9.1%) was also noted. For the CPO cases, *Enterobacter cloacae complex* was the most common, making up two cases (33.3%), with "Other" organisms also comprising two cases (33.3%). Both *Klebsiella pneumoniae* and *Escherichia coli* each accounted for one case (16.7%) of CPO. Notably, no CPO cases were reported for *Acinetobacter baumannii* or *Pseudomonas aeruginosa*, and no CRO cases were reported for *Klebsiella pneumoniae* or the "Other" category.

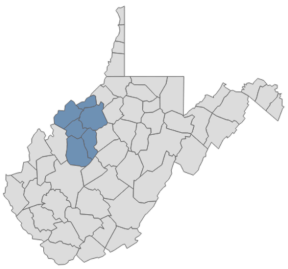

Table 10. CRO (N=11) & CPO (N=6) cases in the Mid-Ohio Valley surveillance region.

CRO & CPO Cases, Mid-Ohio Valley		
	CRO	**CPO**
Organism Cultured		
Acinetobacter baumannii	3 (27.3%)	0
Pseudomonas aeruginosa	4 (36.4%)	0
Klebsiella pneumoniae	0	1 (16.7%)
Enterobacter cloacae complex	3 (27.3%)	2 (33.3%)
Escherichia coli	1 (9.1%)	1 (16.7%)
Other	0	2 (33.3%)

Demographics

Cases by Gender

Overall distribution of gender shows a slightly higher percentage of female cases (53.5%) compared to male cases (46.5%), with no cases reported as 'Other/Unknown'. Female cases accounted for the majority in the Northern (62.5%), Northeastern (53.0%), Eastern (53.8%), Western (60.6%), Central (55.0%), and Mid-Ohio Valley (63.6%) regions. Conversely, male cases were the majority only in the South (56.4%).

Table 11. CRO (N=142) cases by gender by surveillance region.

CRO Cases by Gender by Surveillance Region							
	Northern (N=8)	**Northeast-ern (N=17)**	**Eastern (N=13)**	**Southern (N=39)**	**Central (N=20)**	**Western (N=33)**	**Mid-Ohio Valley (N=11)**
Gender							
Male	3 (37.5%)	8 (47.1%)	6 (46.2%)	22 (56.4%)	9 (45.0%)	13 (39.4%)	4 (36.4%)
Female	5 (62.5%)	9 (53.0%)	7 (53.8%)	17 (43.6%)	11 (55.0%)	20 (60.6%)	7 (63.6%)
Other/Unknown	0	0	0	0	0	0	0

CPO cases in the Northern surveillance region were split among genders, with 20.0% reported as male, 60.0% as female, and 20.0% as other/unknown (N=5). Both the Northeastern (N=8) and Eastern (N=9) regions had an equal percentage of male and female cases at 50.0% in the Northeast, but a significant female predominance in the East at 88.9% (vs. 11.1% male). In the Southern region (N=47), male cases predominated at 61.7% compared to 38.3% female cases. The Western region (N=11) showed a strong male majority at 81.8% (vs. 18.2% female). Similarly, the Central region (N=16) reported 62.5% male cases and 37.5% female cases. Finally, the Mid-Ohio Valley region (N=6) had a substantial female majority, accounting for 83.3% of cases (vs. 16.7% male). No 'Other/Unknown' cases were reported in the Northeastern, Eastern, Southern, Western, Central, or Mid-Ohio Valley regions.

Table 12. CPO (N=102) cases by gender by surveillance region.

CPO Cases by Gender by Surveillance Region							
	Northern (N=5)	**Northeast-ern (N=8)**	**Eastern (N=9)**	**Southern (N=47)**	**Central (N=16)**	**Western (N=11)**	**Mid-Ohio Valley (N=6)**
Gender							
Male	1 (20.0%)	4 (50.0%)	1 (11.1%)	29 (61.7%)	10 (62.5%)	9 (81.8%)	1 (16.7%)
Female	3 (60.0%)	4 (50.0%)	8 (88.9%)	18 (38.3%)	6 (37.5%)	2 (18.2%)	5 (83.3%)
Other/Unknown	1 (20.0%)	0	0	0	0	0	0

Cases by Age

The majority of CRO cases across all surveillance regions involved individuals aged 72 and older. This age group accounted for the highest proportion of cases in the Northern (75.0%), Mid-Ohio Valley (72.7%), Southern (48.7%), Western (45.5%), Central (40.0%), and both the Northeastern and Eastern (46.2% each) regions. The 54-71 age group also represented a substantial number of cases, particularly in the Central (45.0%), Western (39.4%), Southern (33.3%), and Northern (25%) regions. Cases were significantly less common in the younger age groups. The 0-18 age group saw only one case (3.0%) in the Western region. The 19-35 age group had a single case in the Eastern (7.7%) and Central (5.0%) regions. The 36-53 age group had moderate representation across most regions, ranging from 9.1% in the Mid-Ohio Valley to 17.9% in the South.

Table 13. CRO (N=142) cases by age by surveillance region.

CRO Cases by Age by Surveillance Region							
	Northern (N=8)	**Northeast-ern (N=17)**	**Eastern (N=13)**	**Southern (N=39)**	**Central (N=20)**	**Western (N=33)**	**Mid-Ohio Valley (N=11)**
Age							
0-18	0	0	0	0	0	1 (3.0%)	0
19-35	0	0	1 (7.7%)	0	1 (5.0%)	0	0
36-53	0	3 (17.6%)	3 (17.6%)	7 (17.9%)	2 (10.0%)	4 (12.1%)	1 (9.1%)
54-71	2 (25%)	3 (17.6%)	3 (17.6%)	13 (33.3%)	9 (45.0%)	13 (39.4%)	2 (18.2%)
≥72	6 (75.0%)	6 (46.2%)	6 (46.2%)	19 (48.7%)	8 (40.0%)	15 (45.5%)	8 (72.7%)

The distribution of CPO cases across surveillance regions varied significantly by age group. Notably, the 0-18 age group reported zero cases across all regions. In the 19-35 age bracket, a small number of cases were reported in the Southern (one case, 2.1%), Central (one case, 6.25%), and Mid-Ohio Valley (one case, 16.7%) regions, with none in the others. The 36-53 age group saw a wider spread, with cases in the Northern (one, 20.0%), Northeastern (one, 12.5%), Southern (five, 10.6%), Central (four, 25.0%), and Western (three, 27.3%) regions. The majority of CPO cases were concentrated in the older age groups. The 54-71 age group accounted for a substantial portion of cases across all regions, particularly in the Northeastern (six cases, 75.0%) and Southern (22 cases, 46.8%) regions. Similarly, the greater than 72 age group represented a high percentage of cases, especially in the Eastern (six cases, 66.7%) and Mid-Ohio Valley (three cases, 50.0%) regions, and was also a major contributor in the Northern (two, 40.0%), Southern (19, 40.4%), Central (five, 31.3%), and Western (three, 27.3%) regions.

Table 14. CPO (N=102) cases by age by surveillance region.

CPO Cases by Age by Surveillance Region							
	Northern (N=5)	**Northeastern (N=8)**	**Eastern (N=9)**	**Southern (N=47)**	**Central (N=16)**	**Western (N=11)**	**Mid-Ohio Valley (N=6)**
Age							
0-18	0	0	0	0	0	0	0
19-35	0	0	0	1 (2.1%)	1 (6.25%)	0	1 (16.7%)
36-53	1 (20.0%)	1 (12.5%)	0	5 (10.6%)	4 (25.0%)	3 (27.3%)	0
54-71	2 (40.0%)	6 (75.0%)	3 (33.3%)	22 (46.8%)	6 (37.5%)	5 (45.5%)	2 (33.3%)
≥72	2 (40.0%)	1 (12.5%)	6 (66.7%)	19 (40.4%)	5 (31.3%)	3 (27.3%)	3 (50.0%)

Cases by Race

Analysis of CRO cases by race reveals that the majority of cases across all regions are among the White population. Specifically, White individuals accounted for a very high percentage of cases, ranging from 85.0% in the Central region to 100% in the Eastern and Mid-Ohio Valley regions. Cases among the Black or African American population were less frequent, with the highest percentages observed in the Northern (12.5%) and Central (15.0%) regions, and no reported cases in the Eastern, Southern, or Mid-Ohio Valley regions. The 'Other/Unknown' race category represented a small fraction of cases, appearing in the Northeastern (5.9%), Southern (2.6%), and Western (3.0%) regions.

Table 15. CRO Cases (N=142) by race by surveillance region.

CRO Cases by Race by Surveillance Region							
	Northern (N=8)	**Northeast-ern (N=17)**	**Eastern (N=13)**	**Southern (N=39)**	**Central (N=20)**	**Western (N=33)**	**Mid-Ohio Valley (N=11)**
Race							
White	7 (87.5%	15 (88.2%)	13 (100%)	38 (97.4%)	17 (85.0%)	30 (90.9%)	11 (100%)
Black or African American	1 (12.5%)	1 (5.9%)	0	0	3 (15.0%)	2 (6.1%)	0
Other/Unknown	0	1 (5.9%)	0	1 (2.6%)	0	1 (3.0%)	0

When examining CPO isolates by surveillance region and race, the majority of isolates were from White individuals across all regions. Specifically, the Northern, Eastern, and Western regions reported 100% of CPO isolates from White individuals (5/5, 9/9, and 11/11, respectively). The other regions also showed high percentages of White isolates: Southern (91.5%, 43/47), Northeastern (87.5%, 7/8), Central (87.5%, 14/16), and Mid-Ohio Valley (83.3%, 5/6). Black or African American individuals accounted for isolates in the Northeastern (12.5%, 1/8), Southern (6.4%, 3/47), and Central (12.5%, 2/16) regions, but none in the Northern,

Eastern, Western, or Mid-Ohio Valley regions. Isolates categorized as "Other/Unknown" were found only in the Southern (2.1%, 1/47) and Mid-Ohio Valley (16.7%, 1/6) regions.

Table 16. CPO Cases (N=102) by race by surveillance region.

CPO Cases by Race by Surveillance Region							
	Northern (N=5)	**Northeast-ern (N=8)**	**Eastern (N=9)**	**Southern (N=47)**	**Central (N=16)**	**Western (N=11)**	**Mid-Ohio Valley (N=6)**
Race							
White	5 (100%)	7 (87.5%)	9 (100%)	43 (91.5%)	14 (87.5%)	11 (100%)	5 (83.3%)
Black or African American	0	1 (12.5%)	0	3 (6.4%)	2 (12.5%)	0	0
Other/Unknown	0	0	0	1 (2.1%)	0	0	1 (16.7%)

Cases by Ethnicity

Across the surveillance regions, the majority of CRO cases occurred in non-Hispanic individuals. In the Northern (N=8), Northeastern (N=8), Eastern (N=9), and Mid-Ohio Valley (N=11) regions, 100% of the cases were non-Hispanic. High percentages of non-Hispanic cases were also observed in the Western (97.0%, N=33), Central (95.0%, N=20), and Southern (92.3%, N=39) regions. No cases were reported in Hispanic individuals across any of the surveillance regions. Cases categorized as "Other/Unknown" ethnicity accounted for 7.7% of cases in the Southern region (N=3), 3.0% in the Western region (N=1), and 5.0% in the Central region (N=1).

Table 17. CRO Cases (142) by ethnicity by surveillance region.

CRO Cases by Ethnicity by Surveillance Region							
	Northern (N=8)	**Northeast-ern (N=8)**	**Eastern (N=9)**	**Southern (N=39)**	**Western (N=33)**	**Central (N=20)**	**Mid-Ohio Valley (N=11)**
Ethnicity							
Non-Hispanic	8 (100%)	8 (100%)	9 (100%)	36 (92.3%)	32 (97.0%)	19 (95.0%)	11 (100%)
Hispanic	0	0	0	0	0	0	0
Other/Unknown	0	0	0	3 (7.7%)	1 (3.0%)	1 (5.0%)	0

The distribution of Carbapenemase-Producing Organisms (CPO) cases by ethnicity across surveillance regions shows a high prevalence in the non-Hispanic population. Specifically, the Northern, Northeastern, Eastern, Western, and Central regions reported 100% of their cases as non-Hispanic. The Southern region reported the vast majority of cases (95.7%) as non-Hispanic, with 4.3% falling into the "Other/Unknown" category. The Mid-Ohio Valley region also saw a

high percentage of non-Hispanic cases at 83.3%, with 16.7% categorized as "Other/Unknown." Notably, no Hispanic cases were reported in any of the surveillance regions.

Table 18. CPO Cases (N=102) by ethnicity by surveillance region.

CPO Cases by Ethnicity by Surveillance Region							
	Northern (N=5)	**Northeast-ern (N=8)**	**Eastern (N=9)**	**Southern (N=47)**	**Western (N=11)**	**Central (N=16)**	**Mid-Ohio Valley (N=6)**
Ethnicity							
Non-Hispanic	5 (100%)	8 (100%)	9 (100%)	45 (95.7%)	11 (100%)	16 (100%)	5 (83.3%)
Hispanic	0	0	0	0	0	0	0
Other/Unknown	0	0	0	2 (4.3%)	0	0	1 (16.7%)

Discussion

The state reported 244 total CRO cases, with 102 (42%) confirmed as CPOs. KPC remained the most common carbapenemase (51%), but its prevalence continued to decrease, while OXA-like enzymes followed (39%), and New Delhi Metallo-β-lactamase (NDM) cases nearly doubled to 14%. The most frequently reported organisms were *P. aerogenes*, *A. baumannii*, and *K. pneumoniae*. The South Surveillance Region reported the highest number of both CRO and CPO cases, and the majority of cases occurred in older age groups. Additionally, 15 total *C. auris* cases were reported, all originating in acute care settings, with some detected in out-of-state facilities. A significant limitation of the data is the lack of complete carbapenemase testing for many CRO cases, poor completeness of case investigation data in the surveillance system, and difficulties in accurately detecting *C. auris* in laboratory settings.

Recommendations

To overcome the challenges in data completeness and enhance surveillance, efforts will focus on improving the completion rate of key investigation data by LHDs. This can be accomplished through:

- **Targeted training and technical assistance** for LHD staff on the importance of complete data fields and methods for thorough investigation.
- **Streamlining data collection tools and processes** to make it easier and more efficient for LHDs to gather the required information.
- **Implementing data quality checks and feedback loops** to promptly notify LHDs of missing data for priority areas (Antimicrobial use, Indwelling devices, Resident of NH or LTC status).
- **Collaborating with healthcare facilities and LTCs** to improve reporting and access to patient information needed for these specific fields.
- **Increase Carbapenemase Testing Awareness and Participation:** Promote enrollment and utilization of the ARLN program to provide access to carbapenemase testing.

- **Improve *C. auris* Detection:** Continue to educate providers, facilities, and laboratories on the West Virginia Reportable Disease Rule requirements.

Infection prevention efforts should be intensified and targeted, particularly in high-risk settings and populations:

- **Prioritize LTC Settings:** Given that exposure to healthcare and hospitalization in LTAC and LTCs are major risk factors, facilities should strengthen adherence to infection prevention measures, including:
    - Implementing standard and contact precautions, or EBP in nursing homes, for patients colonized or infected with MDROs.
    - Utilizing the 77.2% compliance rate for LTC education to sustain high-level IPC practices in those settings.
- **Target Vulnerable Patient Groups:** Focus on individuals aged 72 and older, those with chronic diseases, and immunocompromised patients, as they represent the majority of cases across all surveillance regions.
- **Reduce Indwelling Device Utilization:** Work with facilities to implement policies to minimize the presence of medical devices such as urinary catheters and central venous lines, as these are identified clinical risk factors for MDRO infection.

To counteract antimicrobial misuse, which is a major risk factor, continued efforts will be aimed at:

- **Strengthening Antimicrobial Stewardship Programs:** Incorporate evidence-based prescribing practices and ensure facility-wide adoption of CDC's Core Elements of Antimicrobial Stewardship.
- **Increasing Public Health Education:** Aggressively invest in education and awareness to continue educating providers, patients, and the public on the risks of antimicrobial overuse and misuse.

Healthcare facilities needing assistance to develop or strengthen infection prevention programs should continue to request support from the HAI/AR program, including:

- **ICAR team:** For guidance in identifying and mitigating gaps in infection control.
- **WV Project Firstline:** For infection control training for frontline healthcare workers to strengthen preparedness.

Summary/Conclusion

The 2025 report documents a persistent and significant public health challenge in West Virginia posed by MDROs, specifically noting 244 total CRO cases, 102 (42%) of which were confirmed as CPOs. The most frequently reported organisms overall were *P. aerogenes*, *A. baumannii*, and *K. pneumoniae*. KPC remained the most common carbapenemase (51%), but its share decreased, while NDM cases nearly doubled to 14%. Additionally, 15 total cases of the highly resistant yeast, *C. auris*, were reported, all originating in acute care settings. The Southern Surveillance Region reported the highest number of both CRO and CPO cases, and the majority of all cases occurred in older age groups (age 72 and older).

The ability to accurately track and mitigate these threats is heavily limited by data gaps, including unknown carbapenemase production status for 76 CRO cases and poor completeness of key investigation data in WVEDSS, particularly concerning antimicrobial use, indwelling devices, and LTC residency. Major risk factors for MDRO infection identified in the report include exposure to healthcare, hospitalization in LTACs and LTCs, frequent antimicrobial use (more than two times in the last six months), and the presence of indwelling medical devices. To address these challenges, the report recommends enhancing surveillance completeness, increasing carbapenemase and *C. auris* testing awareness, prioritizing infection prevention measures (like EBP) in LTC settings, strengthening antimicrobial stewardship programs, and maximizing the use of state support resources such as the ICAR team and WV Project Firstline.

MDRO Public Health Challenge in West Virginia (2025 Report Findings):

- Case Numbers:
    - Two hundred and forty-four total Carbapenem-Resistant Organism (CRO) cases documented.
    - One hundred and two (42%) of CRO cases were confirmed as Carbapenemase-Producing Organism (CPO) cases.
    - Fifteen total cases of the highly resistant yeast, *C. auris*, reported, all from acute care settings.
- Most Common Organisms:
    - Overall most frequently reported were *P. aerogenes*, *A. baumannii*, and *K. pneumoniae*.
- Carbapenemase Trends:
    - KPC remained the most common carbapenemase (51% share), but its proportion decreased.
    - NDM cases nearly doubled, reaching 14% of CPO cases.
- Demographics and Geography:
    - The Southern Surveillance Region reported the highest number of both CRO and CPO cases.

    - The majority of all cases occurred in older age groups (age 72 and older).
- Limiting Factors/Data Gaps:
    - Unknown carbapenemase production status for 76 CRO cases.
    - Poor completeness of key investigation data in WVEDSS, specifically concerning:
        - Antimicrobial use
        - Indwelling devices
        - Long-Term Care (LTC) residency
- Major Risk Factors for MDRO Infection:
    - Exposure to healthcare
    - Hospitalization in LTACs and LTCs
    - Frequent antimicrobial use (more than two times in the last six months)
    - Presence of indwelling medical devices
- Key Recommendations:
    - Enhance surveillance completeness.
    - Increase awareness for carbapenemase and *C. auris* testing.
    - Prioritize infection prevention measures (like Evidence-Based Practices, EBP) in LTC settings.
    - Strengthen antimicrobial stewardship programs.
    - Maximize the use of state support resources (ICAR team, WV Project Firstline).