

Carbapenem-Resistant *Pseudomonas aeruginosa*

Surveillance Protocol

Background ^(1,6)

Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) are gram-negative bacteria that are resistant to the broad-spectrum, “last resort” carbapenem class of antibiotics. Patients with CRPA infections have significantly worse outcomes than patients with susceptible infections. Certain CRPA are resistant because they produce carbapenemase enzymes (e.g., KPC, NDM, OXA, VIM, IMP) that make carbapenems ineffective. Carbapenemase genes can be transferred between different kinds of bacteria and lead to the spread of antibiotic resistance.

Carbapenemase-producing organisms (CPO) are increasingly more common throughout West Virginia healthcare settings, making surveillance of CRPA an important aspect of prevention and control efforts.

Public Health Significance ^(2,4,5,6)

Pseudomonas aeruginosa (*P. aeruginosa*) is intrinsically resistant to many antimicrobial drugs, making carbapenems crucial in clinical management. Infections caused by *P. aeruginosa* are associated with substantial morbidity and mortality rates; a recent study of bloodstream infections showed that patients with a *P. aeruginosa* bloodstream infection had a higher mortality rate than patients with infections caused by members of Enterobacteriaceae or other non-lactose fermenting gram-negative bacilli.

Two to 3% of CRPA carry a mobile genetic element that makes a carbapenemase enzyme. This enzyme makes carbapenem antibiotics ineffective. Mobile genetic elements are easily shared between bacteria, rapidly spreading resistance that destroys these important drugs. In January 2023, the Council of State and Territorial Epidemiologists (CSTE) expanded the case definition for Carbapenemase-Producing Organism (CPO) to include *P. aeruginosa*. Decreasing the impact of these organisms requires a coordinated effort involving a variety of stakeholders including healthcare facilities and providers, public health, and industry. In 2022, CRPA incidence in West Virginia was 3.3 cases per 100,000 population.

Provider Responsibilities

1. Ensure that your laboratory is immediately reporting carbapenem-resistant test results to you and that your office staff notifies you of CRPA results immediately.
2. When you are notified by your laboratory that your patient has CRPA:
 - a. Follow Centers for Disease Control and Prevention (CDC) recommendations: www.cdc.gov/pseudomonas-aeruginosa/media/pdfs/crpa-handout-508.pdf.
 - b. Notify the Infection Preventionist at the facility where the patient is hospitalized; and/or
 - c. Ensure that the Infection Preventionist and other providers are notified before a patient is admitted or transferred so that they can also follow CDC guidelines.
3. Immediately notify the local health department (LHD) of CRPA outbreaks in your facility.

Office of Epidemiology and Prevention Services

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CRPA

Surveillance Protocol

Laboratory Responsibilities

1. Report CRPA immediately to healthcare facilities. Clearly highlight carbapenem resistance on the report so resistance is readily apparent to healthcare providers.
2. Report all positive CRPA tests to the LHD within one week of the result. Report the result by electronic messaging when feasible.
3. Follow current guidelines from the CDC/Clinical and Laboratory Standards Institute (CLSI) for testing for carbapenem resistance.
4. Follow the guidance provided by the West Virginia Office of Laboratory Services (OLS) for sending CRPA specimens to OLS for further characterization.

LHD Responsibilities

Complete the CRPA Case Report Form by contacting the provider and/or facility listed on the lab report, as well as the patient and/or their family, as needed.

1. Enter lab results and complete information from the CRO Disease Reporting Form into the West Virginia Electronic Disease Surveillance System (WVEDSS) in a timely manner.
2. Encourage labs to report electronically when feasible.
3. When a case of CRPA is identified in a LTCF in your county, assess the facility's knowledge about CRPA using the "Initial Assessment for Long-term Care Facility (LTCF) Reported Case of Carbapenem-Resistant Organisms (CRO) including Carbapenem-Resistant Enterobacterales (CRE)". This assessment can be found here:
www.oeps.wv.gov/cre/Documents/LHD/CRO%20Including%20CRE%20Initial%20Assessment%20.pdf
 - a. Provide education and resources to the facility based on the assessment results, including the "CRO including CRE Infection Prevention and Control Guidance ", available at:
www.oeps.wv.gov/cre/Documents/HCP/CRO%20including%20CRE%20Infection%20Prevention%20and%20Control%20Guidance.pdf

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Surveillance Protocol

4. When a case of CRPA is identified in an outpatient setting or the case's LTCF residential status is "No" or "Unknown":
 - a. Contact the patient and/or their family, as appropriate, to verify LTCF residential status and provide education/resources to the patient/family, including the "CRO including CRE Patient FAQ" and link to or provide copies of information from the CDC patient information page.
www.oeps.wv.gov/cre/documents/community/Patient%20FAQ.pdf.
 - b. If you notice a rise in reported CRPA above your county endemic level, or baseline, or you notice multiple cases for a healthcare provider(s), contact the provider(s) to supply education/resources, including the link to the CDC clinician FAQ information page. Report these situations to the West Virginia Department of Health immediately.
<https://www.cdc.gov/pseudomonas-aeruginosa/media/pdfs/crpa-handout-508.pdf>.
 - c. For providers/facilities with multiple CRPA cases, consult with the Bureau for Public Health Healthcare-Associated Infections, Antimicrobial Resistance (HAI AR) program for assistance in determining if there is an outbreak. Email: OEPSMDRO@wv.gov Phone: (304) 558-5358 ex.2.

Bureau for Public Health Responsibilities

1. Provide updated educational resources and materials to the facility, patient, and healthcare personnel.
2. Maintain awareness of new developments in medical literature and through ongoing surveillance.
3. Provide technical expertise and consultation regarding reporting, investigation, or control of cases or outbreaks of CRPA, including direct support of outbreak investigation if needed.
4. Summarize surveillance data for new cases of CRPA on at least an annual basis.
5. Serve as liaison between clinical laboratories, LHD, and OLS for the shipping of CRPA isolates to OLS and/or CDC for further characterization.

Disease Control Objectives

Prevent additional cases of CRPA through:

- Investigation of CRPA outbreaks and delivery of recommendations related to outbreak control/resolution.
- Education of patients and healthcare providers, including LTCFs and outpatient providers, as appropriate, about CRPA prevention and control.

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Disease Prevention Objectives

Reduce the incidence of CRPA by:

- Providing education and resources related to preventing transmission of CRPA.

Surveillance Objectives

- Determine the incidence and regional distribution of CRPA in West Virginia.
- Detect outbreaks of CRPA.
- Describe demographic characteristics of persons with CRPA in West Virginia.

Clinical Description ⁽²⁾

Patients can be infected or colonized with CRPA. Colonization occurs when the organism lives and reproduces in or on a patient's body, but does not cause symptoms or disease. A colonized individual can still transmit the bacteria to others and can go on to develop an infection themselves. Several species of *Pseudomonas*, whether CPO or not, may acquire resistance mechanisms from either living or dead drug-resistant bacteria.

CRPA can cause many types of healthcare-associated infections including pneumonia, bloodstream infections, urinary tract infections, and surgical site infections.

Etiologic Agent ⁽¹⁾

P. aeruginosa is commonly found in the environment, particularly in freshwater. It is commonly an opportunistic pathogen and is also an important cause of nosocomial infections like ventilator-associated pneumonia, catheter-associated urinary tract infections, and others.

For CRPA surveillance purposes, any CRPA species should be reported as noted on the WVEDSS CRO Report Form: www.oeps.wv.gov/cre/Documents/LHD/Case%20Report%20Form%20.pdf.

Reservoir ^(1,6)

The reservoir for CRPA infections in the United States is colonized and infected individuals, especially patients with frequent contact with the healthcare system. *P. aeruginosa* can survive on inanimate objects such as bed rails, countertops, and on medical equipment such as catheter tubing and flexible endoscopes. Other reservoirs in healthcare settings include potable water, taps, sinks, toothbrushes, icemakers, disinfecting solutions, sanitizers, soap bars, respiratory therapy equipment, endoscopes, and endoscope washers.

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Mode of Transmission ^(1,6)

CRPA is transmitted person-to-person through direct contact with infected bodily tissues or fluids. In healthcare settings, CRPA is spread mainly through the hands of healthcare workers and direct contact with contaminated environmental services such as bed rails and computer keyboards.

Incubation Period ⁽¹⁾

The incubation period is not well defined, particularly due to the ability of CRPA to colonize an individual for an extended period.

Infectious Period ⁽¹⁾

CRPA can potentially be transmitted as long as the organisms are present in a person's bodily tissues or fluids. It is unknown how long CRPA can live on inanimate surfaces. These bacteria are capable of transmitting resistance mechanisms in the absence of living organisms.

Outbreak Recognition

Outbreak recognition involves ongoing and systematic CRPA surveillance using a standardized case definition in each facility. CRPA surveillance will allow one to determine when an increase in cases above the baseline occurs and should trigger an investigation into the reason for the increase.

Case Definition ⁽²⁾

CRPA are defined as *Pseudomonas* that are:

- Resistant to any carbapenem (minimum inhibitory concentrations of ≥ 8 mcg/ml for meropenem, imipenem, and doripenem).

OR

- Positive phenotypic test (e.g., Carba NP, Carbapenem inactivation method (CIM), Modified Hodge test, Metallo- β -lactamase test) result for carbapenemase production, with or without identification of a specific carbapenemase gene (e.g., blaKPC, blaNDM, blaVIM, blaIMP, blaOXA-48, but other carbapenemase genes include but are not limited to: blaSIM, blaGIM, blaSPM, other OXA genes, etc.)

OR

- Positive molecular test (e.g., BD Max Check-Points CPO, FilmArray (BioFire), Nucleic acid amplification test (NAAT) (e.g., PCR), Whole-genome sequencing (WGS) result detecting a carbapenemase gene.

OR

- Detection of a carbapenemase gene by NGS

OR

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- Specimen positive for a carbapenemase gene without bacterial species identification, (e.g., Xpert Carba-R rectal swabs, other CIDT)

Preventive Interventions ⁽¹⁾

Prevention of CRPA transmission requires a coordinated effort involving a variety of stakeholders including healthcare providers, acute and long-term care facilities, and state and local public health departments. It requires an understanding of the local and regional prevalence of these organisms, rapid identification of colonized and infected patients in healthcare settings, and implementation of facility-specific and regional interventions to prevent transmission.

Facility-specific prevention measures include:

- Onsite infection control assessments
 - Contact the HAI program to schedule an Infection Control Assessment and Response (ICAR). Email: OEPSICAR@wv.gov
- Educate all healthcare personnel (HCP) and environmental services (EVS) personnel about CRPA.
- Reinforce and follow hand hygiene practices.
- Use Transmission-Based Precautions
 - Contact precautions including gown and gloves.
 - Enhanced Barrier Precautions for nursing home residents.
- Monitor adherence to infection control practices and provide feedback.
- Ensure adequate supplies are available.
- Ensure appropriate signage is on the patient's door to alert HCP and visitors of recommended precautions.
- Collaborate with laboratories regarding testing and notification.
- Implement antimicrobial stewardship.
- Consider screening for CRPA upon admission and colonization screening.
 - Information on colonization screening can be found here:
www.cdc.gov/antimicrobial-resistance-laboratory-networks/media/pdfs/CRE-lab-test-508.pdf.

Treatment ⁽¹⁾

Treatment options for CRPA are extremely limited and may lead to adverse reactions. Infectious disease consultation is recommended for treatment decisions.

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Surveillance Indicators

The purpose of CRPA surveillance indicators in West Virginia is to ensure the sufficient performance of surveillance and case investigation and to identify areas of improvement. The West Virginia Department of Health, Bureau for Public Health, Office of Epidemiology and Prevention Services currently monitors the following indicators through WVEDSS on a regular basis and reports annually.

- The proportion of investigations with complete demographic information.
- The proportion of investigations with complete antimicrobial sensitivity information.
- The proportion of investigations with complete information on LTCF residence.
- The proportion of LTCFs that were provided education on CRPA.

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Surveillance Protocol

References

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