

# Carbapenem-Resistant Organisms

<b>Key Info</b>	<b>Public health should investigate all CRO that test positive for carbapenemase.</b> Public health investigation is not required for carbapenemase-negative CROs except for suspected outbreaks.
<b>Signs and Symptoms</b>	CRO infections have no defining clinical symptoms. Common infections caused by these organisms include wound, urine, and blood. CRO can also colonize and cause no symptoms.
<b>Incubation</b>	CROs may colonize the intestines, skin, and other body sites without causing infection, therefore the incubation period is not well defined.
<b>Case classification</b>	<b>Clinical criteria:</b> None
	<b>Confirmed:</b> Patient with a clinical or screening test yielding Enterobacterales, <i>Pseudomonas aeruginosa</i> or <i>Acinetobacter baumannii</i> positive for known carbapenemase gene or positive on phenotypic test for carbapenemase. (See Appendix I for details about confirmatory tests.)
	CRO isolates that test negative for carbapenemase should be classified as <b>ruled out</b> . CRO isolates not submitted to a PHL for carbapenemase testing should be classified as <b>suspect</b> .
<b>Treatment</b>	Antibiotics for carbapenem-resistant Enterobacterales (CRE) and CRO infections are limited; recommend infectious disease (ID) consultation. Colonization should not be treated except in extremely rare situations and under supervision of ID specialist. PHL offers <a href="#">Expanded Antimicrobial Susceptibility Testing</a> (ExAST) for hard-to-treat infections due to CRE.
<b>Duration</b>	CROs can silently colonize intestines, skin, and other body sites. Duration of colonization is variable and may be associated with healthcare and antibiotic exposure. See Appendix III for guidance on evaluating a patient for clearance of colonization.
<b>Exposure</b>	<ul style="list-style-type: none"> <li>• Healthcare, particularly high acuity healthcare settings and indwelling medical devices.</li> <li>• Direct contact with colonized or infected skin or body fluids.</li> <li>• Indirect contact <ul style="list-style-type: none"> <li>○ CROs can survive on inanimate surfaces for long periods, including on shared/mobile medical equipment and contaminated surfaces in the healthcare environment.</li> <li>○ Healthcare workers' hands.</li> </ul> </li> <li>• Travel or healthcare in regions where these organisms are more common</li> </ul>
<b>Laboratory testing</b>	<ul style="list-style-type: none"> <li>• Isolate genus and species identification, carbapenemase testing, antibiotic susceptibility testing (AST)</li> <li>• Screening for colonization by PCR or culture-based test</li> <li>• All isolates and samples must be submitted using the Electronic Test Ordering and Results (ETOR) system.</li> <li>• See <a href="#">ARLN Lab Test Menu   Washington State Department of Health</a> for instructions on specimen collection and submission.</li> <li>• <a href="#">Expanded antimicrobial susceptibility testing</a> (ExAST) for clinical care is available for CRE. Pre-approval required from AR Lab Network (<a href="mailto:ARLN@doh.wa.gov">ARLN@doh.wa.gov</a>)</li> </ul>
<b>Public health actions</b>	<p>Local health jurisdictions: notifiable to Washington State Department of Health (DOH) Office of Communicable Disease Epidemiology (CDE) within 7 days of completing the investigation or 21 days of receipt of case or lab report. <b>Only carbapenemase positive cases or healthcare outbreaks must be investigated by public health.</b></p> <p><i>Infection Control:</i></p> <ul style="list-style-type: none"> <li>• Place cases on appropriate transmission-based precautions and, if feasible, in a private room.</li> <li>• Reinforce adherence to hand hygiene, proper PPE use, and environmental cleaning.</li> <li>• See <a href="#">What to do if you identify a targeted multidrug resistant organism in your facility</a> and Appendix II in this document.</li> </ul>

# Carbapenem-Resistant Enterobacterales (CRE) and other Carbapenem-Resistant Organisms

## 1. DISEASE REPORTING

### A. Purpose of Reporting and Surveillance

1. To increase awareness of carbapenem-resistant Enterobacterales (CRE) and other carbapenem-resistant organisms (CRO) by public health and healthcare professionals.
2. To promote appropriate infection control interventions to prevent transmission of CRE and other CRO within and between healthcare facilities and the community.
3. To rapidly identify carbapenemase-producing CRE (CP-CRE) and other carbapenemase-producing-organisms (CPO) and prevent or eliminate sources or sites of ongoing transmission within Washington.
4. To characterize the epidemiology of these infections in Washington to guide response.

### B. Required Reporting

1. Health care providers and health care facilities: notifiable to **local health jurisdiction** (LHJ) within 3 business days.
  - Per [WAC 246-101-101](#), CRE isolates limited to those due to *Enterobacter* species, *E. coli* and *Klebsiella* species.
  - Per [WAC 246-101-015](#), by Secretary of Health request of [provisional reporting for CPOs](#), all carbapenem resistant (CR) isolates of Enterobacterales, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*, suspected and confirmed carbapenemase producing isolates, and all confirmed CPO cases. See Appendix I, Table 2 for confirmatory carbapenemase tests.
2. Laboratories: notifiable to **local health jurisdiction** within 2 business days; isolate submission required
  - Per [WAC 246-101-201](#), *Enterobacter* species, *E. coli*, and *Klebsiella* species,
    - a. Positive for known carbapenemase resistance gene (including but not limited to KPC, NDM, VIM, IMP, or OXA-48-like) demonstrated by nucleic acid detection (NAT or NAAT) or whole genome sequencing;
    - b. Positive on a phenotypic test for carbapenemase production including but not limited to Metallo-B-lactamase test, CarbaNP, Carbapenem Inactivation Method (CIM) or modified CIM (mCIM); See Appendix I, Table 2 for confirmatory carbapenemase tests.
    - c. Resistant to any carbapenem including but not limited to ertapenem, imipenem or meropenem (minimum inhibitory concentrations of  $\geq 4$  mcg/ml for meropenem, and imipenem, or  $\geq 2$  mcg/ml for ertapenem).

- Per [WAC 246-101-015](#), by Secretary of Health request of [provisional reporting for CPOs](#),
  - a. Carbapenem resistant isolates of Enterobacterales, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii* for which the species is not intrinsically resistant. See Appendix I, Table 1 for antimicrobial susceptibility criteria.
  - b. Isolates with preliminary or confirmed positive carbapenemase. See Appendix I, Table 2 for confirmatory carbapenemase tests.

See [ARLN Test Menu](#) and [Specimen Collection and Submission Instructions](#) for details on isolate submission.

3. Local health jurisdictions: notifiable to Washington State Department of Health (DOH) Office of Communicable Disease Epidemiology (CDE) within 7 days of case investigation completion or summary information required within 21 days
  - Per [WAC 246-101-505](#) and [WAC 246-101-015](#),
    - a. Confirmed carbapenemase producing organism cases. See Appendix I, Table 2 for confirmatory carbapenemase tests.

### **C. Local Health Jurisdiction (LHJ) Investigation Responsibilities**

1. LHJs should investigate and report all confirmed carbapenemase producing organism (CPO) cases to identify the source and whether transmission has occurred. Enter the case into the Washington Disease Reporting System (WDRS) under Highly Antibiotic Resistant Organism (HARO). In most situations, isolates with mCIM positive but negative for a known carbapenemase will undergo whole genome sequencing to identify novel carbapenemases. See section 3.C for details on case classification.
2. Any outbreak or suspected outbreak in a healthcare facility is immediately reportable to LHJs and should be investigated.
3. LHJs should ensure proper infection prevention precautions are in place in the healthcare facility where the case receives care. See Section 5B for detailed recommendations about infection prevention in healthcare settings.

## **2. THE DISEASE AND ITS EPIDEMIOLOGY**

### **A. Etiologic Agent**

Enterobacterales constitute a large order of Gram-negative bacilli, many of which are normal inhabitants of the intestinal tract in humans, other mammals, and birds. Enterobacterales most commonly encountered in healthcare settings include the taxonomic families, Enterobacteriaceae, Morganellaceae, and Yersiniaceae (see [NCBI Taxonomy Browser](#) for more details), including the genera *Citrobacter*, *Enterobacter*, *Escherichia*, *Klebsiella*, *Morganella*, *Proteus*, *Providencia*, and *Serratia*. These bacteria may be harmless but can cause serious infections, particularly in those who are debilitated due to underlying conditions or age, and those with invasive procedures or indwelling medical devices.

*Acinetobacter* and *Pseudomonas* are also Gram-negative bacilli (not in the order, Enterobacterales). They are common inhabitants of soil and water, may colonize human skin (both) and intestines (*Pseudomonas*), frequently contaminate the hospital

environment, and may cause opportunistic infections.

Carbapenem antibiotics (ertapenem, imipenem, and meropenem) are broad spectrum (active against many different groups of bacteria) and usually reserved for severe life-threatening infections. Certain Gram-negative bacilli, including the order, Enterobacterales, and genera, *Pseudomonas* and *Acinetobacter*, have acquired carbapenem resistance which limits options for treating infections due to these organisms. The mechanism of resistance can be varied; the most concerning are carbapenemases, enzymes produced by bacteria that inactivate carbapenems. Carbapenemase genes transmitted on plasmids are primarily responsible for the worldwide spread of CPOs. Plasmids are mobile pieces of genetic material that can be passed between bacterial species, otherwise known as horizontal inheritance. This type of inheritance can rapidly increase the prevalence of the trait in a population, particularly where there is high risk of transmission such as in a healthcare environment.

Carbapenemases of global importance include *Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo- $\beta$ -lactamase-type 1 (NDM-1), Verona integron encoded metallo- $\beta$ -lactamase (VIM), imipenemase metallo- $\beta$ -lactamase (IMP), and oxacillinase-48 (OXA-48).

Non-carbapenemase carbapenem resistance in the Enterobacterales and other Gram-negative bacteria, such as *Pseudomonas* and *Acinetobacter*, occurs via a combination of mechanisms, typically production of an extended-spectrum  $\beta$ -lactamase or extended-spectrum cephalosporinase (also called ESBL or AmpC) plus decreased permeability of the bacterial cell wall (e.g., porin mutations) to influx of carbapenem antibiotics. Although also multidrug resistant, these organisms are currently thought to have local rather than global importance. CP-CRE, CP-*Pseudomonas* and CP-*Acinetobacter* are becoming more common in Washington and require strict infection control measures and coordinated response between healthcare facilities and public health to prevent them from becoming endemic.

## **B. Description of Illness**

There are no definitive symptoms of CRO infection. CROs can cause a range of infections from superficial (skin) infections to more severe, life-threatening infections, such as bloodstream, urine, and wound infections. Invasive infections due to carbapenem resistant (CR) Enterobacterales and other CR-*Pseudomonas* and CR-*Acinetobacter* are associated with high morbidity and mortality and occur most frequently among persons with prolonged hospitalization, such as those who are chronically or critically ill and have invasive devices such as ventilators, urinary catheters, or central venous catheters. Colonization with these bacteria can also occur and *does not require treatment*, though similar infection control precautions should be used for colonized persons in healthcare settings to prevent transmission to other patients.

## **C. CRE in Washington State**

In Washington, CRE and other CRO are routinely detected by commercial laboratories, but CP-CRE and other CPO are less common. Before systematic reporting began in 2012, 8 CP-CRE had been identified in Washington.

As of end of 2024 in the US, KPC is the most common carbapenemase in

Enterobacterales; in Washington, NDM are slightly more numerous than KPC. The DOH [MDRO Dashboard](#) provides a summary of CRO and CPO surveillance in Washington since 2012. Inpatient healthcare is the most common source of acquisition for carbapenemases.

#### **D. Reservoirs**

Enterobacterales are normally carried in the intestines of many mammals and birds. *Acinetobacter* and *Pseudomonas* exist in water and soil. Carbapenem-resistant infections in the United States are generally associated with healthcare exposures and occur most commonly in those with critical or chronic illness. These Gram-negative organisms can survive on inanimate objects for many months, including in sinks and drains. Humans can be colonized in wounds, catheter exit sites, stool, urine, and sputum and may transmit in the healthcare environment. Colonized persons are at risk for infection from endogenous carriage and this risk increases when indwelling medical devices are present.

#### **E. Modes of Transmission**

Transmission of CRE and other CRO may occur through direct contact with bodily fluids or by skin contact. In healthcare settings, CRE and CRO can be spread via the hands of healthcare workers, on inanimate objects such as medical equipment, bed rails, computer keyboards, in contaminated cleaning supplies, and from colonized sink drains. Transmission has occurred in healthcare settings even when contact precautions were in place, although infection control lapses cannot be ruled out. Persons who are infected or colonized may be a source of transmission to others. The transmission rate for household contacts of cases has not been defined but is thought to be low.

#### **F. Incubation Period**

Because CRE and other CRO can colonize the intestines and other sites without causing infection, the incubation period is not well defined.

#### **G. Period of Communicability**

Colonized or infected persons can transmit CRE and other CRO to others. Patients can be intermittently positive on serial surveillance cultures and may be colonized for long periods of time. Criteria for considering a patient no longer colonized and no longer requiring transmission-based precautions are described in Appendix III. Risk factors for transmitting and contracting CRE and CRO include intensive care, assistance with activities of daily living, chronic wounds and indwelling medical devices. Epidemiologically linked patients in healthcare facilities who have these risk factors are at highest risk for contracting the organism.

#### **H. Treatment**

The antibiotic agents for treating CRE and CRO infections are limited and may cause adverse reactions. In general, colonization should not be treated except in extremely rare situations such as planned bone marrow transplant. Infectious disease consultation is recommended for treatment decisions and when decolonization is being considered. To assist in clinical treatment decisions for pan-resistant Enterobacterales, the PHL can provide [Expanded Antimicrobial Susceptibility Testing](#).

### **3. CASE AND CONTACT DEFINITIONS**

#### **A. Clinical Criteria for Diagnosis of Cases**

There are no specific clinical criteria for diagnosis.

#### **B. Laboratory Criteria for Diagnosis of Cases**

CP-CRE and other carbapenemase producing organisms (CPO): A confirmed carbapenemase-producing CRE (CP-CRE) or CPO case is a patient with a clinical or surveillance specimen

1. Positive for known carbapenemase gene demonstrated by molecular test (e.g., Xpert Carba-R, VERIGENE, Streck ARM-D, Cepheid, or validated laboratory-developed nucleic acid amplification test (NAAT)) or by whole genome sequencing; OR
2. Positive on a phenotypic test for carbapenemase production (e.g., Metallo-B-lactamase (MBL) test, modified Hodge test (MHT), CarbaNP, Carbapenem Inactivation Method (CIM), modified CIM (mCIM), EDTA-modified carbapenem inactivation method (eCIM), or Immunochromatography tests (ICT), OR
3. Positive by other culture independent diagnostic test (CIDT)

For public health surveillance, each unique genus/species/carbapenemase combination in a clinical culture should be counted as a new case once. Clinical cases should be counted only once. Surveillance screening cases may be counted once as a surveillance case and once subsequently as a clinical case. See the [Council of State and Territorial Epidemiologist Position Statement, 22-ID-04](#) for more details about surveillance case counting.

#### **C. Case Classification**

*Confirmed:* CP-CRE or CPO as described in section 3B above.

*Rule out:* CR-isolates that undergo confirmatory testing and are negative for carbapenemase gene

*Suspect:* CR isolates reported to public health but not submitted to a PHL for carbapenemase testing

*Not reportable:* Isolates that do not meet criteria for submission. (See antibiotic susceptibility criteria for submission in Appendix I, Table 1.)

Note: Isolates with PHL test results indicating mCIM positive with SME or hyper-ampC phenotype, or IMI/NMC on sequencing should be classified as “ruled out”. These resistance mechanisms are generally chromosomal and do not warrant a public health response. For other uncommon test results, please consult the HAI MDRO team at [MDRO-AR@doh.wa.gov](mailto:MDRO-AR@doh.wa.gov).

#### **D. Criteria to distinguish a new case**

A patient who is colonized or infected with a CPO based on culture or PCR should be considered colonized. The following criteria should be used for surveillance of CPOs.

- A person with a clinical case should not be counted as a colonization/screening case thereafter (e.g., patient with known infection who later has colonization of skin is not counted as more than one case).
- A person with a colonization/screening case can be later categorized as a clinical case (e.g., patient with positive screening swab who later develops bloodstream infection would be counted once in both categories).

## **4. DIAGNOSIS AND LABORATORY SERVICES**

### **A. Diagnosis**

CRE and CRO are usually identified by bacterial isolation with antibiotic susceptibility testing (AST). See Appendix I for AST criteria for CRE and CRO and confirmatory carbapenemase tests. Most clinical laboratories use automated susceptibility testing methods (e.g., Vitek 2, Trek, Microscan, Phoenix). Traditional methods for determining resistance include broth dilution, disk diffusion, or E test. Resistance should be determined using the most up-to-date resistance breakpoints as set by Clinical Laboratory Standards Institute (CLSI) M100-Ed35. Phenotypic and molecular tests or whole genome sequencing are used to confirm carbapenemase production. Consult the HAI MDRO team at [MDRO-AR@doh.wa.gov](mailto:MDRO-AR@doh.wa.gov) for questions about whether a case meets the definition for CRE, CRO, CP-CRE, or CPO, or should be submitted to PHL for confirmatory testing.

### **B. Services Available at the Washington State Public Health Laboratories (PHL)**

Isolates submitted to PHL undergo species identification, PCR for carbapenemase production, and antimicrobial susceptibility testing (AST). Modified carbapenemase inactivation method (mCIM) phenotypic testing is performed on all CR-Enterobacterales and CR-*Pseudomonas* isolates. Patient specimens submitted for carbapenemase colonization screening undergo RT-PCR to identify carbapenemase production and carbapenemase positive samples are cultured to isolate an organism. Culture-based screening is sometimes performed if the gene target cannot be identified by PCR. Facilities wishing to perform colonization screening must have pre-approval from their LHJ or from DOH.

PHL also offers [Expanded Antimicrobial Susceptibility Testing](#) (ExAST) for hard-to-treat infections. Isolates eligible for submission include Enterobacterales not susceptible to all  $\beta$ -lactams tested, including either ceftazidime/avibactam or meropenem/vaborbactam, OR possess at least one MBL gene (blaNDM, blaVIM, or blaIMP) confirmed by a molecular test. Request preapproval by emailing [ARLN@doh.wa.gov](mailto:ARLN@doh.wa.gov).

All isolates and samples must be submitted using the Electronic Test Ordering and Results (ETOR) system. See [ARLN Lab Test Menu | Washington State Department of Health](#) for instructions on specimen collection and submission.

## **5. CASE INVESTIGATION**

Review laboratory results to confirm genus and species and antimicrobial susceptibility testing to ensure the isolate meets surveillance case definitions, see Appendix I and section 3B for details.

Conduct a public health investigation for all confirmed CPO cases. Case isolates that test negative for carbapenemase do not require public health investigation unless there is suspicion of an outbreak. Review clinical history, medical records and laboratory records and interview the case or others who may be able to provide pertinent information, as needed to collect necessary information. Complete a WDRS case report under “Highly Antibiotic Resistant Organism” (HARO) and complete the HARO wizard question package including the “Clinical and Laboratory” tab.

The guidance, [What to do if you identify a targeted multidrug resistant organism in your facility](#), provides response actions for healthcare facility infection preventionists in order to quickly collect data for CPO investigations and to prevent transmission to others. HAI MDRO staff are available to assist and can be reached at [MDRO-AR@doh.wa.gov](mailto:MDRO-AR@doh.wa.gov).

### **A. Case Management**

Consult an infectious disease specialist for treatment recommendations. In almost all cases, decolonization is not recommended but may be considered prior to immunomodulating therapy such as chemotherapy or bone marrow transplant. For cases with very limited treatment options, the PHL can perform [Expanded Antimicrobial Susceptibility Testing](#) for clinical treatment decisions. See Section 4 above.

### **B. Case Follow Up**

Confirmed cases are entered in the DOH Antibiotic Resistance Information Exchange (ARIE) which sends alerts to public health when they interact with healthcare in the future. The ARIE captures all Washington hospital care (except the long-term acute care hospital) and approximately 75% of skilled nursing facility care. Hospitals can access alerts directly by contacting their Point Click Care customer support to request direct emails for flagged MDRO cases.

### **C. Ensure Infection Control**

Because of the potential for transmission of CRE and other CRO to vulnerable patients in healthcare settings, caregivers should immediately place cases on appropriate transmission-based precautions. Providers should communicate infection or colonization status to patients and family members and educate them about how to prevent transmission in the home using the [appropriate fact sheet](#), and should notify receiving facilities and providers when patients transfer care using an [inter-facility infection control transfer form](#).

In acute care settings such as hospitals and long-term acute care hospitals, carbapenemase-positive patients should be on indefinite contact precautions, ideally in a private room. For nursing home residents infected or colonized with CRE or CRO, at a minimum, [Enhanced Barrier Precautions](#) should be used for all carbapenemase positive cases. The following resources provide detailed guidance on infection prevention precautions for targeted MDROs including CPO.

- [Multi-Drug Resistant Organism Quick Reference Guide and Job Aid Combined \(PDF\)](#)
- [Enhanced Barrier Precautions Quick Guide \(PDF\)](#)
- [Managing Residents with Targeted Multidrug-Resistant Organisms \(MDROs\) in](#)

[Licensed Family Homes Guidance for Public Health \(PDF\)](#)

- [Managing Residents with Targeted Multidrug-Resistant Organisms \(MDROs\) in Licensed Family Homes Guidance for Facility Owners and Staff \(PDF\)](#)
- [Infection Prevention Recommendations for Carbapenemase-Producing Organisms and \*Candida auris\* in Outpatient Settings \(PDF\)](#)

#### D. Identify Potential Sources of Acquisition and Potentially Exposed Persons

Public health should investigate all CPO cases to identify the source, evaluate for lapses in infection control in healthcare settings, and identify potential transmission to other patients. Identify current and past healthcare and underlying conditions, including any hospital or long-term care admissions, roommates, surgeries, dialysis, indwelling catheters, or international healthcare or travel, focusing on the 12 months prior to diagnosis. If the index case has had many healthcare encounters and public health resources are limited, focus the investigation on the 30 days prior to diagnosis. For cases who are in or have recently been in a healthcare facility, the guidance, [What to do if you identify a targeted multidrug resistant organism in your facility](#), can guide facilities through the response and investigation.

## 6. CONTROLLING FURTHER SPREAD

### A. Infection Control Recommendations

See Section 5.C above for general information about infection prevention in healthcare settings.

Patients with a CPO who return to a home setting should be instructed in good hand hygiene. At home, non-professional health caregivers assisting patients with CPOs should perform hand hygiene frequently, especially after contact with wounds, dressings and other contaminated objects or surfaces or helping the patient with toileting and consider using gloves when anticipating contact with body fluids or blood. Professional health caregivers should follow healthcare standards for infection prevention.

When discharging a patient to home, health care providers should communicate *C. auris* status to the patient's primary care team and other healthcare providers in outpatient settings.

### B. Contact Management

Response screening of epi linked patients is recommended when there is potential for spread to others in a healthcare setting. For cases who are currently in or have recently been in a healthcare facility, LHJs should share [What to do if you identify a targeted multidrug resistant organism in your facility](#) with facility staff and request that they complete the worksheet on pages 5-6 in order to identify risks for transmission and whom to screen. Screening healthcare personnel and healthy household contacts is not recommended unless implicated in transmission. **For detailed guidance on whom to target for screening, see Appendix II.**

Please note [CDC MDRO Containment](#) and [Prevention Strategy](#) classifies targeted MDROs into tiers 1, 2 and 3. As of March 2025, DOH classifies all CPOs as tier 2

except KPC, OXA-23, and OXA-235 which are considered tier 3. See **Appendix II for detailed guidance on response activities for tier 2 versus tier 3 organisms.**

Screening in response to a case can be performed free of charge at PHL. Consult with HAI MDRO staff available at [MDRO-AR@doh.wa.gov](mailto:MDRO-AR@doh.wa.gov) for screening instructions and proper collection materials. See section 4B for specimen collection and submission instructions.

#### **D. Environmental Evaluation**

In healthcare settings, ensure that environmental cleaning procedures adhere to [CDC Environmental Infection Control in Health-Care Facilities](#). Facilities should audit environmental services practices and ensure use of a hospital grade disinfectant, adherence to proper contact time, and thoroughness of cleaning. Ensure that reusable medical equipment is properly cleaned and disinfected between use and there is a clear procedure for identifying whether equipment is clean and ready for use.

## **7. ROUTINE PREVENTION**

### **A. Routine Prevention**

Collaboration and coordination between public health agencies and healthcare facilities and help prevent CRO transmission in healthcare settings by strengthening surveillance, rapid identification of colonized and infected patients, and implementing facility-specific and regional interventions to prevent transmission.

Core measures include hand hygiene, transmission-based precautions, educating healthcare personnel, minimizing device use, cohorting staff and patients, laboratory notification, antimicrobial stewardship, and screening for targeted MDROs when indicated.

### **B. Prevention Recommendations**

All persons can adhere to good health hygiene to stop the spread of pathogens by sanitizing hand frequently, especially

- Before preparing or eating food
- After using the bathroom or helping another person with toileting or diapers
- After blowing the nose, coughing or sneezing
- After touching used tissues or handkerchiefs
- Before and after changing wound dressings or bandages

## **ACKNOWLEDGEMENTS**

We would like to acknowledge the Oregon Department of Human Services for developing the format and select content of this document.

## **UPDATES**

March 2014: Updates include submission and reporting requirements for CRE surveillance and local health responsibilities for investigation and infection control; updates are interspersed throughout but affected mainly sections 1B and C, 2A and C, 3B, 4B, and 5B and C.

## **Carbapenem-Resistant Enterobacterales Reporting and Surveillance Guidelines**

April 2015: Updates include a change in CRE surveillance case definition, and submission and reporting requirements; updates are interspersed throughout but affected mainly sections 1B, 3B, and 4B.

November 2016: Updates include changes in case definitions, and added detail about infection control recommendations for different healthcare settings in section 5B and Appendix B. Other updates are interspersed throughout but affected mainly sections 1B, 3B and 5B.

May 2018: Updates include case definitions in section 3B, reporting requirements in section 1B, and new infection prevention guidance resources in section 5B. We have updated the guidance to be applicable to both CRE and other CRO.

June 2021: Updates include changing the taxonomic family name, Enterobacteriaceae, to the more inclusive order name, Enterobacterales, removing Appendix B, table of genera included under Enterobacteriaceae; making the document applicable to other carbapenem resistant organism, and providing links to new guidance materials, including “What to do if you identify a targeted multidrug resistant organism in your facility.”

August 2021: Added Table 1 that defines resistance criteria of bacterial isolates for submission to PHL for carbapenemase testing; clarified that any carbapenemase-producing Enterobacterales, *Acinetobacter* or *Pseudomonas* isolates should be classified as “confirmed” and those testing negative as “not reportable.”

November 2021: Reorganized sections 5 and 6 to remove repetition. Updated infection control recommendations in the appendix to better align with national guidance.

December 2022: For 2023 WAC revision combined provider and facility reporting requirement, updated laboratory submission (Section 1B); updated to reflect addition of provisional reporting of all CR-Enterobacterales, *Pseudomonas*, and *Acinetobacter*; removed Table 1 and replaced it with Appendix I showing AST criteria for reporting and submission of CRE, CR-*Pseudomonas* and CR-*Acinetobacter*.

March 2023: Updated link to Interim Guidance for a Health Response to Contain Novel or Targeted MDROs.

June 2023: Added table on confirmatory carbapenemase tests to Appendix I. Added information about infection prevention in community-based settings such as adult family homes to Appendix II.

January 2024: Updated Section 1.B, Required Reporting, Section 3.C, Case Classification, and Appendix I, Table 1 to be clearer.

June 2024: Updated CDC links.

August 2024: Removed Appendix 2 and added new infection prevention resources to sections 5C and 6A.

April 2025: Updated to reflect changing KPC and OXA-35 and OXA-235 carbapenemases to tier 3.

July 2025: Revised “Suspect” case classification criteria to say “if not submitted to a public health lab” rather than “to WA PHL” to allow for testing at another PHL. Updated Section 4.B to reflect that all isolates and samples must be submitted using the Electronic Test Order and Result system. Updated Section 5 with case investigation guidance and 5.B with information about alerts from the Antibiotic Resistance Information Exchange. Updated Section 6.C describing tier 2 versus tier 3 carbapenemase producing organisms. Appendix II was added to describe how to tailor response actions depending on tier.

To request this document in another format, call 1-800-525-0127. Deaf or hard of hearing customers, please call 711 (Washington Relay) or email [doh.information@doh.wa.gov](mailto:doh.information@doh.wa.gov).

**Appendix I: Reporting and submission criteria for carbapenem resistant Enterobacterales, *Acinetobacter baumannii* and *Pseudomonas aeruginosa***

AI, Table 1: Antimicrobial susceptibility test criteria for laboratories to report and submit carbapenem resistant Enterobacterales, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*

Bacterial Order, Family or Genus	Antibiotic Resistance Criteria
Carbapenem-resistant Enterobacterales <sup>1</sup> (excluding <i>Morganella</i> , <i>Proteus</i> , and <i>Providencia</i> spp.)	Resistant to ≥ 1 carbapenem: Minimum inhibitory concentrations (MIC) ≥4 µg/ml for meropenem, ≥4 µg/ml for imipenem, ≥ 2 µg/ml for ertapenem <b>OR</b> Kirby-Bauer zone of inhibition diameter (ZID) ≤ 19 mm for meropenem, ≤ 19 mm for imipenem, ≤ 18 mm for ertapenem
Carbapenem-resistant <i>Morganella</i> , <i>Proteus</i> and <i>Providencia</i> spp.	Resistant to ≥ 1 carbapenem <b>excluding imipenem</b> : MIC ≥ 4 µg/ml for meropenem, ≥ 2µg/ml for ertapenem <b>OR</b> Kirby-Bauer ZID ≤ 19 mm for meropenem, ≤ 18 mm for ertapenem
Carbapenem-resistant <i>Acinetobacter baumannii</i>	Resistant to ≥1 carbapenem <b>excluding ertapenem</b> : MIC ≥8 µg/mL for meropenem, ≥8 µg/mL for imipenem <b>OR</b> Kirby-Bauer ZID ≤ 14 mm for meropenem, ≤ 18 mm for imipenem
Carbapenem-resistant <i>Pseudomonas aeruginosa</i> (non-mucoid)	Resistant to ≥1 carbapenem, <b>excluding ertapenem</b> : MIC ≥ 8 µg/mL for meropenem, ≥ 8 µg/mL for imipenem, <b>AND</b> MIC ≥ 16 µg/mL for ceftazidime or ≥ 16 µg/mL for cefepime <b>OR</b> Kirby-Bauer ZID ≤ 15 mm for meropenem, ≤ 15 mm for imipenem <b>AND</b> Kirby Bauer ZID ≤ 17 mm for ceftazidime or ≤ 17 mm for cefepime

<sup>1</sup>Refer to National Center for Biotechnology Information Taxonomy Browser for a list of bacterial families, genera and species in the taxonomic order, Enterobacterales <https://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=91347>.

**Carbapenem-Resistant Enterobacterales Reporting and Surveillance Guidelines**

AI, Table 2: Confirmatory carbapenemase tests for laboratories, facilities and healthcare providers to report for carbapenem resistant *Enterobacterales*, *Acinetobacter baumannii*, and *Pseudomonas aeruginosa*

Category of Test	Examples
Phenotypic Test <sup>1</sup>	<ul style="list-style-type: none"> <li>• Metallo-β-lactamase (MBL) test</li> <li>• RAPIDEC Carba NP</li> <li>• Modified carbapenem inactivation method (mCIM)</li> <li>• EDTA-modified carbapenem inactivation method (eCIM)</li> <li>• Hardy NG Carba-5 Immunochromatography test (ICT)</li> </ul>
Molecular Test <sup>1</sup>	<ul style="list-style-type: none"> <li>• Cepheid Xpert Carba-R</li> <li>• Luminex VERIGENE</li> <li>• Streck ARM-D β-lactamase</li> <li>• Validated laboratory-developed nucleic acid amplification test (NAAT)</li> </ul>
Next Generation Sequencing (NGS)	<ul style="list-style-type: none"> <li>• Detection of a carbapenemase gene</li> </ul>
Culture Independent Diagnostic Test	<ul style="list-style-type: none"> <li>• Other culture independent diagnostic test (CIDT)</li> </ul>

<sup>1</sup>Isolates that are phenotypically positive for carbapenemase production but negative for a carbapenemase gene via a molecular test should be reported and submitted.

**Appendix II: Tier 2 and Tier 3 Targeted MDRO Containment Response**

This appendix guides LHJ investigators in response actions based on whether the organism is classified by DOH as tier 2 or tier 3. LHJs may apply their own tier categorization.

**Definitions**

Tier 2 Targeted MDROs	Tier 3 Targeted MDROs
<ul style="list-style-type: none"> <li>• <i>Candida auris</i></li> <li>• OXA-48-like, NDM, VIM, &amp; IMP carbapenemases</li> <li>• Pan-resistant KPC carbapenemases</li> <li>• Pan-resistant OXA-23-like &amp; OXA-235-like carbapenemases in <i>Acinetobacter</i></li> </ul>	<ul style="list-style-type: none"> <li>• KPC carbapenemases (if not pan-resistant)</li> <li>• OXA-23-like &amp; OXA-235-like carbapenemases in <i>Acinetobacter</i> (if not pan-resistant)</li> </ul>

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**Containment Response Actions for Tier 2 and 3 targeted MDROs**

<p><b>1. Initial Response</b></p> <ul style="list-style-type: none"> <li>• Promptly implement appropriate transmission-based precautions (TBP) in current facility.</li> <li>• If resources allow, consider offering an Infection Control Assessment and Response (ICAR) visit to facility where case is currently if none conducted in prior 6 months or if the infection preventionist is new.</li> <li>• If a facility has recently participated in a prior ICAR visit, assess their progress in mitigating previously identified infection control gaps.</li> <li>• Ensure patient and home caregivers have been notified and educated about the MDRO.</li> <li>• Ensure healthcare personnel who care for the patient are notified about the organism (e.g., infection control department, current healthcare staff, primary care provider). If the organism was likely present on admission, ensure the prior facility is notified.</li> </ul>
<p><b>2. Healthcare Investigation</b></p>

- For cases who are currently in, or have recently been in, a healthcare facility, LHJs should share [What to do if you identify a targeted multidrug resistant organism in your facility](#) with facility staff and request that they complete the worksheet on pages 5-6 in order to identify risks for transmission and whom to screen.
- Complete the HARO wizard question package including the “Clinical and Laboratory” tab.
- Conduct interview except in rare cases when a known outbreak or international healthcare is the most likely source.
- Review healthcare in the prior 12 months, focusing on the most recent 30 days.

*Special considerations for tier 3*

- Limit healthcare investigation to current facility unless
  - Healthcare in prior 30 days was in a facility/region where organism has never/rarely been identified.
  - Healthcare in prior 30 days was in a high acuity\* or long length of stay facility.\*\*
  - Organism was present on admission and previous facility was likely place of acquisition.

### 3. Contact Investigation

- Recommend response screening of other patients at facilities where index case received care in the prior 30 days, prioritizing current facility and high acuity\* or long length of stay facilities.\*\*
  - Timing of screening influences whom to screen. Ideally, screening should be performed within several days of case identification.
    - Consider limiting screening to epi-linked patients (e.g., those in nearby rooms or who received similar care such as wound care, respiratory care, mobile x-ray, physical therapy) if the facility can identify epi-linked patients and screen within several days ( $\leq 1$  week) of index case identification.
    - If screening  $> 1$  week after index case is identified, a point prevalence survey on the unit is recommended.
  - Always screen those who shared a room or bathroom, even if the index patient was on appropriate TBP.
    - For *C. auris*, consider screening patient(s) currently admitted to room/bed spaces where the index case stayed, and the patient who occupied the space just AFTER index case if still hospitalized.
    - For patients who shared these spaces and already discharged home, LHJs can notify and screen these patients, or ask the healthcare facility to flag their chart for screening if they are readmitted in the next 6 months.
  - For CPOs, screening is recommended unless the patient was either
    - Admitted for  $< 24$  hours on a lower acuity, short stay ward, or was
    - On appropriate TBP for the entire hospitalization
  - For *C. auris*, screening is recommended in all inpatient medical settings including nursing homes except when the diagnosis was known on admission, the patient was on appropriate transmission based precautions, and an [effective disinfectant](#) was in use.

*Special considerations for Tier 3*

- Limited screening of epi-linked patients:

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- Always screen those who shared a room or bathroom, as for tier 2.
- Follow tier 2 screening guidance for screening other epi linked patients if
  - The patient likely acquired the organism in the facility.
  - The case was identified in a facility or region where the organism has never or rarely been identified.
  - Admission was to a high acuity\* or long length of state facility.\*\*
  - The KPC or CRAB OXA carbapenemase is pan-resistant.
  - If there is other evidence or suspicion for transmission on the unit.
- For tier 3 organisms, outside of the criteria above, no additional screening is recommended.

\*High acuity healthcare facility/setting: Intensive care, burn, cancer, or pediatric care unit, ventilator capable skilled nursing facility (vSNF), long term acute care hospital (LTACH)

\*\*Long length of stay facility: Nursing home, vSNF, LTACH.

**Appendix III: Criteria for evaluating a patient for clearance of CPO colonization**

Patients who are infected or colonized with a carbapenemase producing organism (CPO) may remain colonized for months and even years (1-3). People may become colonized with a CPO during healthcare, during travel to regions where these resistance mechanisms are more common (4), through contact with animals (5), and perhaps through other community sources (6). Some studies have found that antibiotic use and high acuity inpatient care may prolong duration of colonization (1-3), and patients may test positive again after several serial negative tests. For these reasons, DOH recommends maintaining most CPO-colonized patients on transmission-based precautions indefinitely in healthcare settings. A follow up study of three healthy travelers who acquired CPO-colonization during travel and had not taken antibiotics demonstrated clearance within 1-3 months (7). Other studies tracking duration of colonization with multidrug resistant Enterobacteriaceae found persistent carriage at 12 months in 2-11% of travelers but information about underlying conditions and antibiotic use among those with persistent colonization was not provided (6-8). Based on these limited data, we propose that a patient meet all of the following criteria to remove the CPO colonization label and the need for transmission-based precautions in healthcare settings.

- They have recovered from their acute illness.
- They do not have indwelling medical devices, wounds or incontinence.
- They have no significant need for assistance with activities of daily living,
- At least 1 year has elapsed since the most recent positive culture (either screening or clinical).
- They are not currently being treated with antibiotics
- Two or more consecutive rectal screening sample swabs collected at least a week apart are negative.

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