# Carbapenem-Resistant Organisms

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| **Key Info** | **Public health should investigate all CRO that test positive for carbapenemase**. Public health investigation is not required for carbapenemase-negative CRO except for suspected outbreaks. |
| **Signs and Symptoms** | CRO have no defining clinical symptoms. Common infections caused by these organisms include wound, urine, and blood, but CRO can colonize and cause no symptoms. |
| **Incubation** | CRO may colonize the intestines, skin, and other body sites without causing infection, therefore the incubation period is not well defined. |
| **Case classification** | **Clinical criteria**: None |
| | **Confirmed:** Patient with a clinical or surveillance test yielding Enterobacterales, *Pseudomonas aeruginosa* or *Acinetobacter baumannii* positive for known carbapenemase gene or positive on phenotypic test for carbapenemase. (See Appendix I for details about tests.) |
| | CRO isolates that test negative for carbapenemase should be classified as **ruled out**. CRO isolates that are not tested for carbapenemases should be classified as **suspect**. (See Section 3C) |
| **Treatment** | Antibiotic treatments for carbapenem-resistant Enterobacterales (CRE) and CRO infections are limited; recommend infectious disease (ID) consultation for treatment decisions. Colonization should not be treated except in rare situations and under supervision of ID specialist. PHL offers expanded antimicrobial susceptibility testing (ExAST) for hard-to-treat infections due to CRE. |
| **Duration** | CRO can silently colonize intestines, skin, and other body sites. Duration of colonization is variable and can be associated with healthcare and antibiotic exposure. Colonization may lead to endogenous infection and can spread to others. |
| **Exposure** | • Healthcare, particularly high acuity healthcare settings and indwelling devices.<br>• Direct contact with colonized or infected skin or body fluids.<br>• Indirect contact<br>  ○ CRO survives on inanimate surfaces for long periods, including shared/mobile medical equipment, and contaminated surfaces such as bedrails, etc.<br>  ○ Healthcare workers' hands.<br>• Travel or healthcare in certain parts of the world (including the US) |
| **Laboratory testing** | • Isolate genus and species identification, carbapenemase testing, antibiotic susceptibility testing (AST)<br>• Screening for colonization by PCR or culture-based test<br>• Use Antibiotic Resistance Lab Network (ARLN) Requisition Form for isolate submission. For screening, submit using Electronic Test Ordering and Results (ETOR) entry.<br>• Ship isolates on Choc, HIA, BHI slant (plate ok if submitted via courier), ambient, category B.<br>• Screening rectal swab provided in PHL-approved collection kit, ambient, category B.<br>• Expanded antimicrobial susceptibility testing (ExAST) for clinical care is available on CRE. Pre-approval required from AR Lab Network (ARLN@doh.wa.gov) |
| **Public health actions** | 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. **Only carbapenemase positive cases or healthcare outbreaks must be investigated by public health.**<br>*Infection Control:*<br>• Place cases on appropriate transmission-based precautions, and in a private room if feasible.<br>• Reinforce hand hygiene, proper PPE use, and environmental cleaning.<br>• See What to do if you identify a targeted multidrug resistant organism in your facility |

# 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 to 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 baumanii,* 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; submission required – isolate or, if no isolate, submit specimen associated with positive result, within 2 business days
   - 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 ≥ 4 mcg/ml for meropenem, and imipenem, or ≥ 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 in order 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). Consult with OCDE for cases with mCIM positive test but negative for a named carbapenemase. See section 3.C for details on case classification.

   LHJs should be notified by laboratories of CRO, and by healthcare providers and facilities of confirmed CPO isolates or cases and should ensure that CRO isolates are submitted to PHL. LHJs may choose to perform a preliminary investigation on carbapenem resistant organism cases while phenotypic or mechanistic testing for carbapenemase production is performed at PHL or may wait for confirmatory results before starting the investigation.

2. Any outbreak or suspected outbreak in a healthcare facility, including of CROs, is immediately reportable to LHJs and should be investigated.

3. Because of the potential for transmission of CRO to vulnerable patients in healthcare settings, providers and facilities should institute appropriate infection control precautions when CRO are identified. See Section 5B for recommendations about infection prevention in healthcare settings. The LHJ may reinforce appropriate infection preventions messaging but implementation and communication of CRO status to the patient or home caregivers, including how to prevent transmission, is the responsibility of healthcare providers, infection preventionists, and facilities.

## 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 or can cause serious infections in humans, particularly in those who are debilitated due to serious illness or age and those with invasive procedures or indwelling catheters.

*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 developed carbapenem resistance which limits options for treating infections due to these organisms. The mechanism of resistance can be varied; most concerning are carbapenemases, enzymes produced by bacteria that inactivate carbapenems directly. 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-β-lactamase-type 1 (NDM-1), Verona integron encoded metallo-β-lactamase (VIM), imipenemase metallo-β-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 β-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 the most aggressive infection control measures and coordinated response between healthcare facilities and public health in order to prevent them from becoming endemic.

### C. 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 rates of 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 in order to prevent transmission to other patients. Colonized patients are at risk for invasive infection from their own endogenous colonization and this risk increases when indwelling devices are present.

### D. 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 2023, 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 remains the most likely reported 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.

### 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 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 attack rate for household contacts of cases has not been defined but is thought to be very 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

Persons can potentially transmit CRE and other CRO to others as long as the organisms are present in bodily fluids or on their body. Patients can be intermittently positive on serial surveillance cultures and may be colonized for long periods of time. Persons at highest risk for transmitting and contracting CRE and CRO are those who require intensive care, assistance with activities of daily living, or have wounds or indwelling devices. Epidemiologically linked patients within the healthcare environment (roommates, those who shared healthcare staff or equipment) are thought to be 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.

## 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 test (MBL), 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, no subsequent surveillance cases should be counted. 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 complete testing and are negative for carbapenemase gene

*Suspect*: CR isolates reported to public health but not submitted to 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 that are mCIM positive with SME or hyper-ampC phenotype reported by PHL should be classified as "ruled out". These resistance mechanisms do not warrant public health response. For other uncommon test results, please consult the HAI MDRO team at MDRO-AR@doh.wa.gov.

## 4. DIAGNOSIS AND LABORATORY SERVICES

### A. Diagnosis

CRE and CRO are most commonly diagnosed 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-Ed34. 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.for questions about determining whether a case meets the definition for CRE, CRO, CP-CRE, or CPO, or about submission to PHL for confirmatory testing.

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

At PHL, all isolates undergo species identification and PCR for carbapenemase production. Modified carbapenemase inactivation method (mCIM) phenotypic testing is performed on all CR-Enterobacterales and CR-*Pseudomonas* isolates. PHL also performs antimicrobial susceptibility testing (AST).

Specimens submitted from patients for carbapenemase screening undergo RT-PCR performed to identify carbapenemase production. Culture-based screening is sometimes performed if the target is not identified by PCR. PHL provides free screening supplies and instructions for collection. Pre-approval is required for carbapenemase screening through the HAI MDRO team at MDRO-AR@doh.wa.gov.

For clinical purposes, PHL also offers expanded antimicrobial susceptibility testing (ExAST) for hard-to-treat infections. Isolates eligible for submission include Enterobacterales not susceptible to all β-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. Preapproval is required by emailing ARLN@doh.wa.gov. See details at Expanded Antimicrobial Susceptibility Testing.

When submitting clinical specimens to PHL, include the Antibiotic Resistance Lab Network (ARLN) Requisition Form. When submitting screening samples, use Electronic Lab Ordering and Results. (ETOR). Note that PHL requires all clinical and screening

specimens to have two unique patient identifiers, a name **and** a second identifier (e.g., date of birth), on both the specimen label and the submission form. **These patient identifiers must match exactly.** Due to laboratory accreditation standards, specimens will be rejected for testing if not properly identified. Also include specimen source and collection date.

## 5. CASE INVESTIGATION

Review laboratory results to confirm genus and species and antimicrobial susceptibility testing to ensure the isolate meets the CRE, CRO, CP-CRE or CPO surveillance case definition, see Appendix I and section 3B for details.

The guidance, What to do if you identify a targeted multidrug resistant organism in your facility, provides response actions for LHJs and 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 206-418-5500.

### 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 immune-modulating 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; pre-approval is required. See Section 4 above.

### B. Case Follow Up

Conduct a public health investigation for all confirmed CP-CRE and 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.

### C. Ensure Infection Control

Because of the potential for transmission of CRE and other CRO to vulnerable patients in healthcare settings, providers, infection preventionists, and facilities should immediately implement appropriate precautions when cases are identified. Providers should also communicate infection or colonization status to patients and family members and educate them about how to prevent transmission in the home using a CRO Patient Notification form, and to receiving facilities and providers when patients transfer care using an inter-facility infection control transfer form.

In general, in acute care settings such as hospitals and long-term acute care hospitals, carbapenemase positive patients should be cared for in private rooms with indefinite application of contact precautions.

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)
- Carbapenem-Resistant Enterobacterales Infection Control (CDC)
- 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 CP-CRE and CPO cases to identify the source and evaluate for lapses in infection control in healthcare settings and potential transmission to other patients. Public health should ensure that adequate infection prevention practices are in place, that the patient is educated, and that appropriate information regarding the patient's MDRO status is communicated to healthcare providers and facilities where the patient receives care. Identify current and past healthcare and underlying conditions, including any hospital or long-term care admissions, 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 1 month prior to diagnosis. The guidance What to do if you identify a targeted multidrug resistant organism in your facility will help LHJs and facilities quickly perform the investigation. See Section 6C for management of potentially exposed contacts.

## 6. CONTROLLING FURTHER SPREAD

### A. Infection Control Recommendations

In general, patients with CPO infection or colonization should be placed on contact precautions and in nursing homes on Enhanced Barrier Precautions (unless CP are more appropriate).

When transferring patients, it is essential that all receiving facilities are notified of the patient's CPO status at the time of admission so appropriate infection control can be implemented. Use of the inter-facility infection control transfer form, or a similar method can ensure that complete information is communicated. Additional resources on infection control for *CPOs* are available.

- Multi-Drug Resistant Organism Quick Reference Guide and Job Aid Combined (PDF)
- Enhanced Barrier Precautions Quick Guide (PDF)
- Carbapenem-Resistant Enterobacterales Infection Control (CDC)
- Infection Prevention Recommendations for Carbapenemase-Producing Organisms and *Candida auris* in Outpatient Settings (PDF)

Patients with a CPO who return to a home setting should be instructed in good hand hygiene, especially after touching the infected area, both contaminated dressings, and after using the bathroom. People providing care at home for 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. This is particularly important if the caregiver is caring for more than one ill person. When discharging a patient to home, health care providers should communicate the patient's MDRO status to the patient's primary care team to and other healthcare providers in outpatient settings.

### C. Contact Management

Epidemiologically linked contacts (defined in section 5D) of a CP-CRE or CPO case who have symptoms or signs compatible with infection (fever, pneumonia, sepsis, draining wound, dysuria) should be placed in transmission-based precautions and evaluated promptly by a healthcare provider.

When there is potential for spread to others in a healthcare setting, review What to do if you identify a targeted multidrug resistant organism in your facility to identify whom to screen. For further guidance on surveillance screening, see Interim Guidance for a Health Response to Contain Novel or Targeted MDROs (CDC).

Screening in response to a case can be performed free of charge at PHL. Consult with HAI MDRO staff available at 206-418-5500 for screening instructions and proper collection materials. See section 4B for specimen collection and submission instructions.

Please note CDC MDRO Containment and Prevention Strategy classifies targeted MDROs into tiers 1, 2 and 3. Washington classifies all carbapenemases, including KPC and OXA, and *Candida auris* as Tier 2. Surveillance screening testing can be performed free of charge at PHL. Consult with the HAI MDRO team at MDRO-AR@doh.wa.gov for guidance on screening recommendations, instructions, and proper collection materials.

### 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 ensuring use of a hospital grade disinfectant, adherence to proper contact time, and completeness 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

Prevention of CRE and CRO transmission in healthcare settings requires collaboration and coordination between public health agencies and healthcare facilities, including surveillance, rapid identification of colonized and infected patients in healthcare settings, and implementing facility-specific and regional interventions to prevent transmission.

Core measures that facilities should follow include hand hygiene, contact precautions, education of healthcare personnel, minimizing device use, cohorting staff and patients, laboratory notification, antimicrobial stewardship, and screening for *C. auris* 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.

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.

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.

## 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[1] (excluding *Morganella*, *Proteus*, and *Providencia* spp.) | Resistant to ≥ 1 carbapenem:<br>Minimum inhibitory concentrations (MIC) ≥4 µg/ml for meropenem, ≥4 µg/ml for imipenem, ≥ 2 µg/ml for ertapenem<br>**OR**<br>Kirby-Bauer zone of inhibition diameter (ZID) ≤ 19 mm for meropenem, ≤ 19 mm for imipenem, ≤ 18 mm for ertapenem |
| Carbapenem-resistant *Morganella, Proteus* and *Providencia* spp. | Resistant to ≥ 1 carbapenem **excluding imipenem**:<br>MIC ≥ 4 µg/ml for meropenem, ≥ 2µg/ml for ertapenem<br>**OR**<br>Kirby-Bauer ZID ≤ 19 mm for meropenem, ≤ 18 mm for ertapenem |
| Carbapenem-resistant *Acinetobacter baumanii* | Resistant to ≥1 carbapenem **excluding ertapenem**:<br>MIC ≥8 µg/mL for meropenem, ≥8 µg/mL for imipenem<br>**OR**<br>Kirby-Bauer ZID ≤ 14 mm for meropenem, ≤ 18 mm for imipenem |
| Carbapenem-resistant *Pseudomonas aeruginosa* (non-mucoid) | Resistant to ≥1 carbapenem, **excluding ertapenem**:<br>MIC ≥ 8 µg/mL for meropenem, ≥ 8 µg/mL for imipenem,<br>**AND**<br>MIC ≥ 16 µg/mL for ceftazidime or ≥ 16 µg/mL for cefepime<br>**OR**<br>Kirby-Bauer ZID ≤ 15 mm for meropenem, ≤ 15 mm for imipenem<br>**AND**<br>Kirby Bauer ZID ≤ 17 mm for ceftazidime or ≤ 17 mm for cefepime |

[1]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.

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[1] | • Metallo-β-lactamase (MBL) test<br>• RAPIDEC Carba NP<br>• Modified carbapenem inactivation method (mCIM)<br>• EDTA-modified carbapenem inactivation method (eCIM)<br>• Hardy NG Carba-5 Immunochromatography test (ICT) |
| Molecular Test[1] | • Cepheid Xpert Carba-R<br>• Luminex VERIGENE<br>• Streck ARM-D β-lactamase<br>• Validated laboratory-developed nucleic acid amplification test (NAAT) |
| Next Generation Sequencing (NGS) | • Detection of a carbapenemase gene |
| Culture Independent Diagnostic Test | • Other culture independent diagnostic test (CIDT) |

[1]Isolates that are phenotypically positive for carbapenemase production but negative for a carbapenemase gene via a molecular test should be reported and submitted.