



WEDSS Surveillance and Response for Targeted Multidrug-Resistant Organisms: Wisconsin Protocol for Local and Tribal Health Departments

Healthcare-Associated Infections (HAI) Prevention Program
Division of Public Health | Wisconsin Department of Health Services



WISCONSIN DEPARTMENT
of HEALTH SERVICES

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Introduction and Purpose

The Centers for Disease Control and Prevention (CDC) have designated several multidrug-resistant organisms (MDROs) to be of special interest for surveillance and interventions. As of [July 1, 2022](#), confirmed or probable cases of the following are considered [Category II reportable diseases](#) in Wisconsin:

- Carbapenemase-producing organisms, including:
 - Carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE)
 - Carbapenemase-producing carbapenem-resistant *Pseudomonas aeruginosa* (CP-CRPA)
 - Carbapenemase-producing carbapenem-resistant *Acinetobacter baumannii* (CP-CRAB)
- *Candida auris* (*C. auris*)

This guide is intended to provide local and Tribal health departments (LTHDs) an overview on these four organisms. This guide can help LTHDs interpret lab results and determine the appropriate follow-up needed. Additional information and resources for these organisms can also be found on the [DHS Reportable MDROs web page](#).



Since the LTHD initial response procedure (including the process for entering information into the Wisconsin Electronic Disease Surveillance System [WEDSS]) is very similar for CP-CRE, CP-CRPA, CP-CRAB, the initial response process for these three organisms is discussed [starting on page 13 of this guide](#). The initial response process for *C. auris* cases is discussed separately [on page 14 of this guide](#).

Clinical and screening case classification

Both carbapenemase-producing organisms and *C. auris* are classified in WEDSS as either “clinical” or “screening” cases. This is based on the type of specimen that was originally tested for the MDRO.



A **clinical specimen** is collected from an individual for the purpose of diagnosing disease in the normal course of clinical care. It may be collected from any body site such as urine, blood, and wounds.



A **screening specimen** is collected from an individual without clinically compatible illness for the purpose of detection of colonization with the organisms. Common screening specimen sites are skin (such as axilla, groin), rectal, nares, or other external body sites.

CP-CRE

Enterobacterales is an order of bacteria that include some pathogenic species, but also many that exist as normal flora in the human gastrointestinal tract. They can cause infections in health care settings and in people with underlying medical conditions. Most CRE infections involve the urinary tract, though they can also cause bloodstream infections, ventilator-associated pneumonia, and wound infections.

Carbapenem-resistant isolates are almost always MDROs and can be difficult to treat. The type of CRE that is most relevant in the public health setting is CP-CRE, which contain a gene for an enzyme that attacks carbapenem antibiotics.

Case definition

According to Wis. Admin. Code ch. DHS 145, [CP-CRE is considered a Category II level notifiable condition](#) in the state of Wisconsin, which mandates that the disease is reported within 72 hours upon recognition of a case or suspected case to the patient’s local health officer or to the local health officer’s designee. The case can be reported either using an [Acute and Communicable Disease Case Report \(DHS F-44151\)](#) delivered to the fax number or address on the form, or entered into WEDSS. This reflects a change announced in April 2022 for a change from Category I to Category II status as of July 1, 2022.

CP-CRE is [defined](#) according to this statute as any Enterobacterales species that tests positive for carbapenemase production by a phenotypic method or positive for a specific carbapenemase resistance mechanism by molecular or other testing methods.



The acronym CRE previously referred to “carbapenem-resistant *Enterobacteriaceae*,” but was [changed in 2020](#) to refer to the order Enterobacterales instead.

Confirmed case: An isolate of Enterobacterales spp. that is positive for a carbapenemase resistance mechanism (e.g., KPC, NDM, VIM, IMP, OXA-48) by an FDA-approved or validated laboratory-developed test (e.g., PCR, Xpert® Carba-R), or sequencing method.

Probable case: An isolate of Enterobacterales spp. for which the phenotypic test is positive or indeterminate (such as, metallo- β -lactamase test, Carba NP, Carbapenem Inactivation Method [CIM], or modified CIM), but the molecular testing is negative or not performed.

Suspect case: An isolate of Enterobacterales spp. that is resistant on antibiotic susceptibility tests at a clinical lab and no further carbapenemase testing was performed. This includes if the isolate was not sent to the Wisconsin State Laboratory of Hygiene (WSLH) or the test result at WSLH is inconclusive.

Not a case: An isolate of Enterobacterales spp. that tests negative for production of carbapenemase. This includes any isolate that is not resistant to any carbapenem, as those will not be tested further.

Interpretation of laboratory tests

Antibiotic susceptibility tests (AST) establish an antibiotic’s effectiveness against bacteria. Results can be “resistant” (antibiotic is not effective), “intermediate,” or “susceptible” (antibiotic is effective). As part of its routine testing for CP-CRE, WSLH performs bacterial characterization, AST, the modified carbapenemase inactivation method (mCIM) phenotypic test for carbapenemase production, and if

carbapenemase production is detected, identifies which carbapenemase is present (KPC, NDM-1, IMP, VIM, and OXA-48).

Table 1. Resistant results for each carbapenem

Carbapenem	MIC* breakpoints (µg/mL)	Zone diameter (mm)
Doripenem	≥ 4	≤ 19
Ertapenem	≥ 2	≤ 18
Imipenem	≥ 4	≤ 19
Meropenem	≥ 4	≤ 19

Table 2. Intermediate results for each carbapenem

Carbapenem	MIC breakpoints (µg/mL)	Zone diameter (mm)
Doripenem	2	20-22
Ertapenem	1	19-21
Imipenem	2	20-22
Meropenem	2	20-22

Table 3. Susceptible results for each carbapenem

Carbapenem	MIC breakpoints (µg/mL)	Zone diameter (mm)
Doripenem	≤ 1	≥ 23
Ertapenem	≤ 0.5	≥ 22
Imipenem	≤ 1	≥ 23
Meropenem	≤ 1	≥ 23

*MIC = Minimum inhibitory concentration

Carbapenemase production

Phenotypic tests: Non-specific tests that indicate production of any carbapenemase

- mCIM: Zone 6–15 mm
- Carba NP: Light orange, dark yellow, or yellow
- Modified Hodge Test (MHT): Enhanced growth

Carbapenemase identification tests

- PCR (for KPC, NDM, OXA-48, OXA-23, OXA-24/40, OXA-58, IMP, or VIM)
- Xpert Carba-R (for KPC, NDM, OXA-48, IMP, or VIM)
- NG-Test Carba-5 (for KPC, NDM, OXA-48, IMP, or VIM)

Whole genome sequencing: Tests for any carbapenemase

WSLH submission guidelines

WSLH requests [submission](#) of isolates from all Enterobacterales species that meet any of the following criteria:

- Resistant to any carbapenem antimicrobial*
- Positive for carbapenemase production using a phenotypic testing method
- Positive for a carbapenemase gene using molecular methods

*For bacteria that have intrinsic imipenem non-susceptibility (such as, *Morganella morganii*, *Proteus* spp., *Providencia* spp.), resistance to a carbapenem other than imipenem is required.

CP-CRPA

Pseudomonas aeruginosa is a bacterial species that is commonly found in soil and water. Isolates of *P. aeruginosa* often have intrinsic resistance to many antibiotics. CP-CRPA is rare, found in about two to three percent of *P. aeruginosa* isolates in the United States, but invasive infections with *P. aeruginosa* can cause serious illness or death. CP-CRPA has been associated with travel and receiving medical care abroad.

Case definition

According to [BCD memo 2022-06](#), CP-CRPA is considered a Category II level notifiable condition in the state of Wisconsin, which mandates that the case should be reported either using an [Acute and Communicable Disease Case Report \(DHS F-44151\)](#) delivered to the fax number or address on the form, or entered into WEDSS, within 72 hours.

CP-CRPA is [defined](#) as any *Pseudomonas aeruginosa* isolate that tests positive or indeterminate for carbapenemase production by a phenotypic method or positive for a carbapenemase resistance mechanism by molecular testing methods.

Confirmed case: An isolate of *Pseudomonas aeruginosa* that is positive for a carbapenemase resistance mechanism (such as, KPC, NDM, VIM, IMP, OXA-48) by an FDA-approved or validated laboratory-developed test (such as, PCR, Xpert® Carba-R), or sequencing method.

Probable case: An isolate of *Pseudomonas aeruginosa* for which the phenotypic test is positive or indeterminate (such as, metallo-β-lactamase test, Carba NP, Carbapenem Inactivation Method [CIM], or modified CIM), but the molecular testing is negative or not performed.

Suspect case: An isolate of *Pseudomonas aeruginosa* that is resistant on antibiotic susceptibility tests at a clinical lab and no further carbapenemase testing was performed. This includes if the isolate was not sent to WSLH or the test result at WSLH is inconclusive.

Interpretation of laboratory tests

Antibiotic susceptibility tests (AST) establish an antibiotic's effectiveness against bacteria. Results can be "resistant" (antibiotic is not effective), "intermediate," or "susceptible" (antibiotic is effective). As part of its routine testing for CP-CRPA, WSLH performs bacterial characterization, AST, the modified carbapenemase inactivation method (mCIM) phenotypic test for carbapenemase production, and if carbapenemase production is detected, individual PCR assays to identify what carbapenemases are present (KPC, NDM-1, IMP, VIM, and OXA-48).

Table 4. Resistant results for each carbapenem

Carbapenem	MIC breakpoints (µg/mL)	Zone diameter (mm)
Doripenem	≥ 8	≤ 15
Imipenem	≥ 8	≤ 15
Meropenem	≥ 8	≤ 15

Table 5. Intermediate results for each carbapenem

Carbapenem	MIC breakpoints ($\mu\text{g/mL}$)	Zone diameter (mm)
Doripenem	4	16-18
Imipenem	4	16-18
Meropenem	4	16-18

Table 6. Susceptible results for each carbapenem

Carbapenem	MIC breakpoints ($\mu\text{g/mL}$)	Zone diameter (mm)
Doripenem	≤ 2	≥ 19
Imipenem	≤ 2	≥ 19
Meropenem	≤ 2	≥ 19

Note: Ertapenem is not effective as a treatment for *Pseudomonas aeruginosa*.

Carbapenemase production

Phenotypic tests: Non-specific tests that indicate production of any carbapenemase

- mCIM: Zone 6–15 mm
- Carba NP: Light orange, dark yellow, or yellow
- Modified Hodge Test (MHT): Enhanced growth

Carbapenemase identification tests:

- PCR (for KPC, NDM, OXA-48, IMP, or VIM)
- Xpert Carba-R (for KPC, NDM, OXA-48, IMP, or VIM)
- NG-Test Carba-5 (for KPC, NDM, OXA-48, IMP, or VIM)

Whole genome sequencing: Tests for any carbapenemase

WSLH submission guidelines

WSLH requests [submission](#) of *Pseudomonas aeruginosa* isolates that meet the following criteria:

- Resistant to at least one carbapenem (other than ertapenem) **and**
- Non-susceptible (intermediate or resistant) to cefepime or ceftazidime.

This resistance profile has been shown to be much more likely to harbor carbapenemase genes. Exceptions can be made for isolates that are susceptible to cefepime and/or ceftazidime but are suspected of producing a carbapenemase. This may include, but is not limited to, when an isolate is from a patient with a history of hospitalization outside the United States or when there is suspicion of transmission within a facility.

Please do not submit CRPA isolates from cystic fibrosis patients. These isolates can be highly resistant but are most likely due to factors other than the presence of a carbapenemase.

CP-CRAB

Acinetobacter baumannii is of increasing concern to CDC and recent data indicates that many resistant isolates are carbapenemase-producing. Infections with CP-CRAB tend to occur among patients with indwelling medical devices, such as tracheostomies, and chronic wounds. Because CRAB can survive on surfaces in the patient environment, it can be very difficult to contain transmission between patients and residents, especially in long-term care facilities (LTCFs).

Case definition

According to [BCD memo 2022-06](#), CP-CRAB is considered a Category II level notifiable condition in the state of Wisconsin, which mandates that the case should be reported either using an [Acute and Communicable Disease Case Report \(DHS F-44151\)](#) delivered to the fax number or address on the form, or entered into WEDSS, within 72 hours.

CP-CRAB is [defined](#) as any *Acinetobacter baumannii* isolate that tests positive for a carbapenemase resistance mechanism by molecular testing methods.

Confirmed case: An isolate of *Acinetobacter baumannii* that is positive for a carbapenemase resistance mechanism (such as, KPC, NDM, VIM, IMP, OXA-48, OXA-23, OXA-24/40, or OXA-58) by an FDA-approved or validated laboratory-developed test (such as, PCR, Xpert® Carba-R), or sequencing method.

Phenotypic tests for carbapenemase production, such as the modified carbapenemase inactivation method (mCIM), are not effective in CRAB and, therefore, not used.

Suspect case: An isolate of *Acinetobacter baumannii* that is resistant on antibiotic susceptibility tests at a clinical lab and no further carbapenemase testing was performed. This includes if the isolate was not sent to WSLH or the test result at WSLH is inconclusive.

Interpretation of laboratory results

Antibiotic susceptibility tests (AST) establish an antibiotic's effectiveness against bacteria. Results can be "resistant" (antibiotic is not effective), "intermediate," or "susceptible" (antibiotic is effective). As part of its routine testing of CP-CRAB, WSLH performs bacterial characterization, AST, and individual PCR assays to identify any carbapenemases (KPC, NDM-1, IMP, VIM, OXA-48, OXA-23, OXA-24/40, and OXA-58).

Table 7. Resistant results for each carbapenem

Carbapenem	MIC breakpoints (µg/mL)	Zone diameter (mm)
Doripenem	≥ 8	≤ 14
Imipenem	≥ 8	≤ 18
Meropenem	≥ 8	≤ 14

Table 8. Intermediate results for each carbapenem

Carbapenem	MIC breakpoints ($\mu\text{g/mL}$)	Zone diameter (mm)
Doripenem	4	15-17
Imipenem	4	19-21
Meropenem	4	15-17

Table 9. Susceptible results for each carbapenem

Carbapenem	MIC breakpoints ($\mu\text{g/mL}$)	Zone diameter (mm)
Doripenem	≤ 2	≥ 18
Imipenem	≤ 2	≥ 22
Meropenem	≤ 2	≥ 18

Note: Ertapenem is not effective as a treatment for *Acinetobacter baumannii*.

Carbapenemase production

Phenotypic tests: Not used for CRAB isolates

Carbapenemase identification tests

- PCR (for KPC, NDM, IMP, VIM, OXA-48, OXA-23, OXA-24/40, OXA-58)

Whole genome sequencing: Test for any carbapenemase

WSLH submission guidelines

WSLH requests [submission](#) of *Acinetobacter baumannii* isolates that meet any of the following criteria:

- Resistant to any carbapenem antimicrobial
- Positive for a carbapenemase gene using molecular methods

C. auris

C. auris is an emerging fungal pathogen that exhibits resistance against several important antifungals and is associated with high morbidity and mortality in infected patients. *C. auris* can also be very difficult to identify using most identification methods. Any unusual *Candida* species isolated at clinical laboratories should be submitted to WSLH for further identification and antifungal susceptibility testing.

Case definition

Laboratory criteria

Confirmatory laboratory evidence:

- Culture and identification of *C. auris* in a specimen collected from any body site **or**
- Demonstration of *C. auris*-specific nucleic acid or protein in a specimen collected from any body site using a validated assay (such as, PCR).

Presumptive laboratory evidence:

- Culture and identification of *Candida haemulonii* in a specimen collected from any body site using a yeast identification method that is not able to detect *C. auris* (see [CSTE position statement 18-ID-05, Appendix 1](#)) **and**
- Isolate/specimen is not available for further testing **or** isolate/specimen has not yet undergone further testing.

Specimen descriptions

- A **clinical specimen** is collected from an individual for the purpose of diagnosing disease in the normal course of care. It may be collected from any body site, including urine, blood, and wounds.
- A **colonization or screening specimen** is a swab collected from an individual without clinically compatible illness for the purpose of screening for *C. auris*, regardless of site swabbed. Typical screening specimen sites are skin (for example, axilla, groin), nares, rectum, or other external body sites.

Wisconsin surveillance [case definition](#)

Clinical:

- **Confirmed case:** An individual with clinical illness and a clinical specimen with confirmatory laboratory evidence of *C. auris*.
- **Probable case:** An individual with clinical illness whose clinical specimen meets presumptive laboratory evidence and has an epidemiologic linkage.
- **Suspect case:** An individual with clinical illness whose clinical specimen meets presumptive laboratory evidence but has no epidemiologic linkage.

Colonized:

- **Confirmed:** An individual whose colonization or screening specimen meets confirmatory laboratory evidence.
- **Probable:** An individual whose colonization or screening specimen meets presumptive laboratory evidence.

Criteria to distinguish a new case

- A person meeting clinical case criteria is counted once and **should not** be counted as a colonization or screening case if colonization is detected after clinical illness.
- A person meeting colonization or screening case criteria who later develops illness and meets clinical case criteria **should** be counted in both categories (in other words, separate WEDSS disease incidents).

WSLH submission guidelines

WSLH requests [submission](#) of *Candida* isolates that meet any of the following criteria:

- *C. auris* or suspect *C. auris*
- Invasive isolates of *C. glabrata*
- *Candida* sp. that are unable to be identified
- Unusual *Candida* species (species other than *C. albicans*, *C. parapsilosis*, *C. dublinensis*, *C. lusitaniae*, *C. tropicalis*, or *C. krusei*)
- *Candida* sp. resistant to two or more antifungal classes

Initial Response Procedures

Procedure for CPOs (CRE, CRAB, CRPA)

✓ Import case into WEDSS

- Case will enter staging as “Carbapenemase-producing organism, unspecified.”
- Based on specimen type, sort cases into either “Carbapenemase-producing organism, clinical” or “Carbapenemase-producing organism, screening.”



A **clinical specimen** is collected from an individual for the purpose of diagnosing disease in the normal course of care. It may be collected from any body site such as urine, blood, or wounds.



A **screening specimen** is collected from an individual without clinically compatible illness for the purpose of detection of colonization with the organisms. Common screening specimen sites are skin (such as axilla, groin), rectal, nares, or other external body sites.

✓ Determine case type (see [case definition](#) for more information)

- If isolate is positive for a carbapenemase:
 1. Follow up with submitting facility to get information on patient or resident and recommend appropriate precautions as outlined in this document.
 2. Fill out case report form (CRF) and enter information into WEDSS.
 3. Set resolution status to **confirmed**.
- If the lab result isn't from WSLH or if the test is inconclusive:
 1. Ensure that the isolate (if it meets [WSLH submission guidelines](#)) has been sent to WSLH for further testing.
 2. Set resolution status to **suspect**.
- If the isolate is positive for a carbapenemase by a phenotypic test (such as mCIM, Carba-NP) and negative for any specific carbapenemase by PCR (this is rare):
 1. Follow up with submitting facility to get information on patient or resident and recommend appropriate precautions as outlined in this document.
 2. Fill out CRF and enter information into WEDSS.
 3. Set resolution status to **probable**.
- If the isolate tests negative for all carbapenemases (usually at WSLH):
 1. Set resolution status to **not a case**.

✓ For all confirmed and probable cases

- Determine health care facility of origin and any other recent health care exposures.
- Call infection preventionists or other providers for any facility where the patient or resident was admitted or resides. Infection preventionists are the best resources for gathering the

information needed for the Lab/Clinical and Risk tabs in WEDSS. [See page 16, General Case Investigation, for more information.](#)

- Ensure that the patient or resident has been placed into proper precautions, based on facility type and organism/mechanism:
 - Hospitals: Contact precautions
 - LTCFs: Contact precautions or enhanced barrier precautions
 - Consult with your [HAI Prevention Program Regional Infection Preventionist](#) with questions regarding the appropriate precautions for the situation.
- ✓ When resolution status is final and above steps are complete, set “process status” to **sent to state**.



A case should be counted as new if any of the following conditions are met:

- The patient tests positive for a different carbapenemase resistance mechanism (KPC, NDM, VIM, IMP, OXA) than previously identified.
- The patient tests positive for a different carbapenemase/organism combination (KPC-*E. coli* and KPC-*Klebsiella pneumoniae*).
- The isolate is from a clinical case where the previous isolate was from screening (for example, a patient with positive axilla or groin screening swab who later develops a wound infection). The opposite, a screening positive in a patient with a previous clinical case, would not be considered a new case.

Procedure for *C. auris*

✓ Import case into WEDSS

- Case will enter staging as “*Candida auris*, unspecified.”
- Based on specimen type, sort cases into either “*Candida auris*, clinical” or “*Candida auris*, screening.”



A **clinical specimen** is collected from an individual for the purpose of diagnosing disease in the normal course of care. It may be collected from any body site such as urine, blood, or wounds.



A **screening specimen** is collected from an individual without clinically compatible illness for the purpose of detection of colonization with the organisms. Common screening specimen sites are skin (such as axilla, groin), rectal, nares, or other external body sites.

✓ Determine case type (see [case definition](#) for more information)

- Determine if existing laboratory evidence is confirmatory or presumptive.
- Determine if specimen is clinical or colonization.
- Determine whether case is confirmed, probable, or suspect.

- For all probable and suspect cases, ensure that the isolate (if it meets [WSLH submission guidelines](#)) has been sent to WSLH for further testing.
- ✓ **For all confirmed and probable cases**
 - Determine health care facility of origin and any other recent health care exposures.
 - Call infection control for any facility where the patient or resident was admitted or resides.
 - Ensure that the patient or resident has been placed into proper precautions, based on facility type and organism/mechanism.
 - Hospitals: Contact precautions
 - LTCFs: Contact precautions or enhanced barrier precautions
 - Consult with your [HAI Prevention Program Regional Infection Preventionist](#) with questions regarding the appropriate precautions for the situation.
- ✓ When resolution status is final and above steps are complete, set “process status” to **sent to state**.

General Case Investigation for Targeted MDROs

Conducting surveillance and case investigations for targeted MDROs is important for identifying the source of the organism and preventing further transmission. Utilizing surveillance tools, such as WEDSS, to identify, record, and track patient or resident demographics and information allows health care facilities to identify a patient or residents MDRO status and ensure appropriate infection control

precautions are followed during the patient's health care encounters. Epidemiologists can also pull exposure information from WEDSS to look for clusters of similar MDROs.

Routine case investigation

- ✓ Collect patient or resident demographic and exposure information. The exposure information includes information on the health care encounter where the specimen was collected, the patient or resident's health care encounter history from the previous year, and the patient or resident's current living situation. A facility's Infection Preventionist or Director of Nursing can typically gather this from the patient or resident's medical record.
 - If you're unsure where the patient's specimen was collected, you may need to call the clinical lab that did the initial testing to find out.
- ✓ Once information has been collected, enter it into the WEDSS disease incident.
- ✓ Look for indications that the organism may have been acquired from the health care encounter or any indications of local transmission. This can include:
 - Previous negative cultures.
 - The first culture of this specific MDRO.
 - Culture collected ≥ 4 days since admission to the facility.
 - Other patients with the same MDRO in the same facility, unit, or wing around the same time.



Connect with the [HAI Prevention Program](#) for next steps or any questions along the way.