Michigan Department of Health and Human Services
Surveillance for Healthcare Associated and Resistant Pathogens (SHARP) Unit
CPO Case Reporting and Investigation Guidance

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Purpose

Carbapenemase-Producing Organisms (CPO) are a significant public health concern and contribute to the growing problem of antibiotic resistance. CPO include any Enterobacterales, *Pseudomonas aeruginosa*, or *Acinetobacter* species, and are a group of multi-drug resistant pathogens that are classified as an urgent public health threat by the Centers for Disease Control and Prevention.

Carbapenem antibiotics (doripenem, ertapenem, imipenem, and meropenem) are active against many different groups of bacteria and are usually reserved for severe infections. Certain organisms have developed a mechanism to resist the effects of carbapenem antibiotics which limits options for treating infections caused by these organisms.

The mechanism of resistance can be varied; for public health surveillance, the focus is on carbapenemases, which are enzymes produced by bacteria. Carbapenemases are beta-lactamase enzymes that inactivate carbapenems and other beta-lactam antibiotics. Resistance due to carbapenemase genes transmitted on mobile genetic elements (plasmids) enable transfer across bacterial species and are primarily responsible for the spread of carbapenemase-producing organisms.

Therefore, CPO reporting is crucially important for identifying and limiting the spread. MDHHS continues to work with clinical laboratories to report CPOs electronically to the Michigan Disease Surveillance System (MDSS). However, in the interim, most CPO case reports may be entered manually by laboratory, infection prevention staff, or local health department (LHD) staff. The following guidance provides additional information for reporting and public health follow-up of CPO cases in MDSS.

Laboratory Reporting

1. Laboratories must report all isolate or specimen of Carbapenamase-producing Organisms (CPO): Any **Enterobacterales** (Table 1), ***Pseudomonas aeruginosa,*** ***Acinetobacter* spp.**, or culture-independent test meeting any of the following laboratory evidence:
    a. Positive phenotypic test (Table 2) result for carbapenemase production
        i. Isolates positive for phenotypic carbapenemase production but negative by molecular tests for known carbapenemase genes should still be reported and submitted.

    b. Positive molecular test (Table 3) result detecting a carbapenemase gene with or without organism identification.
        i. Common carbapenemase genes include blaKPC, blaNDM, blaVIM, blaIMP, blaOXA-48-like, but other genes may include but are not limited to blaSIM, blaGIM, blaSPM, other blaOXA, genes.

    c. Detection of carbapenemase gene by next generation sequencing (NGS)

Table 1. Enterobacterales, all genera (common ones are bolded)

Citrobacter	*Alterococus*	*Dickeya*	*Mangrovibacter*	*Rahnella*
Enterobacter	*Arsenophonus*	*Edwardsiella*	*Metakosakonia*	*Raoultella*
Escherichia	*Averyella*	*Enterobacillus*	*Mixta*	*Rosenbergiella*
Hafnia	*Biostraticola*	*Erwinia*	*Moellerello*	*Rouxiella*
Klebsiella	*Brenneria*	*Ewingella*	*Obesumbacterium*	*Saccharobacter*
Morganella	*Buchnera*	*Franconibacter*	*Pantoea*	*Samsonia*
Proteus	*Budvicia*	*Gibbsiella*	*Pectobacterium*	*Scandinavium*
Providencia	*Buttiauxella*	*Izhakiella*	*Phaseolibacter*	*Shimwellia*
Salmonella	*Calymmatobacterium*	*Kluyvera*	*Phytobacter*	*Siccibacter*
Serratia	*Candidatus*	*Leclercia*	*Phlomoacter*	*Sodalis*

Shigella	*Cedecea*	*Lelliottia*	*Photorhabdus*	*Superficieibacter*
Yersinia	*Chania*	*Leminorella*	*Plesiomonas*	*Tatumella*
	Cosenzaea	*Limnobaculum*	*Pluralibacter*	*Trolbulsiella*
	Cronobacter	*Lonsdalea*	*Pragia*	*Wigglesworthia*
			Pseudoescherichia	*Xenorhabdus*
			Pseudocitrobacter	*Yokenella*

Table 2. Phenotypic tests for carbapenemase production (Pos/Neg) include, but not limited to:

Carba NP
Metallo-β-lactamase testing (e.g., E-test)
Modified Carbapenem Inactivation Method (mCIM)
EDTA-Modified Carbapenem Inactivation Method (eCIM)
Carbapenem Inactivation Method (CIM)
Immunochromatography tests (ICT)

Table 3. Molecular tests for specific type of carbapenemase* (resistance mechanism)

Cepheid Xpert Carba-R®
Nanosphere Verigene BC-GN®
EPlex® BCID GN Panel
FilmArray™ BCID
FilmArray™ pneumonia panel
BD MAX™ Check-Points
Streck ARM-D®
Validated, laboratory developed NAAT (e.g., PCR)

* Common carbapenemases include KPC, NDM, OXA-48, IMP, and VIM, but other examples of carbapenemases include but are not limited to SIM, GIM, SPM, other OXA genes or novel carbapenemase genes.

2. Laboratories must submit all CPO isolates to the MDHHS Bureau of Laboratories (BOL) Lansing laboratory for antimicrobial resistance confirmation (ARC) testing.

3. If laboratories are unable to detect CPOs (i.e., cannot test for carbapenemase production or carbapenemase genes) and only perform susceptibility testing, submit isolates of any Enterobacterales, *Pseudomonas aeruginosa*, or *Acinetobacter* spp. isolate demonstrating resistance profiles defined below (Table 4) to the MDHHS BOL Lansing laboratory for further testing. Clinical laboratories should follow Clinical and Laboratory

Standards Institute (CLSI) guidance (M100) regarding which antimicrobials should be tested for each organism and minimum inhibitory concentration (MIC) breakpoints for each antimicrobial tested.

Table 4. Resistance Profile Isolate Submission Criteria

Organism	Submit any isolate with a minimum inhibitory concentration (MIC)* breakpoint of the following:
Carbapenem-resistant **Enterobacterales (CRE)**	• ≥4 µg/mL for doripenem, or imipenem, or meropenem or • ≥2 µg/mL for ertapenem Note: *Morganella, Proteus,* and *Providencia* spp. may have intrinsic resistance to imipenem. Only those isolates that are resistant to one or more carbapenems other than imipenem should be submitted.
Carbapenem-resistant ***Pseudomonas aeruginosa*** **(CRPA)**	• ≥8 µg/mL to doripenem, or imipenem, or meropenem AND • ≥16 µg/mL to cefepime or ceftazidime
Carbapenem-resistant ***Acinetobacter*** **spp**.	• ≥8 µg/mL for doripenem, or imipenem, or meropenem
Any of the above	Any isolate that is non-susceptible to all antibiotics tested

*When reporting isolates, include the MIC numeric criteria (e.g., ≥4 mcg/ml), not just the interpretation alone (i.e., “Resistant”, “Susceptible”, “Intermediate”)

4. If a CPO is detected via a molecular test directly from a clinical specimen, perform a culture to obtain the bacterial isolate and perform subsequent testing to determine carbapenemase production or carbapenemase gene, and antibiotic susceptibility profile when possible, and submit isolate.

Infection Prevention Reporting

1. Following identification of a confirmed CPO, ensure appropriate healthcare infection control measures are promptly implemented to contain further spread.

2. Report cases to the local health department jurisdiction in which the patient resides- county of residence.

3. Report all cases with laboratory evidence or healthcare records containing a diagnosis of Carbapenamase-producing Organisms (CPO): Any **Enterobacterales** (Table 1), ***Pseudomonas aeruginosa,*** or ***Acinetobacter* spp**., with any of the following criteria:
    a. Any isolate of CPO positive for carbapenemase production by a **phenotypic test** (refer to Table 2)

ⓘ *Phenotypic tests look for the physical characteristics of an organism. For CPO surveillance, this means looking for production of a carbapenemase enzyme that breaks down carbapenem antibiotics conferring resistance to carbapenem antibiotics.*

    b. Any isolate of CPO with a known carbapenemase resistance mechanism by a recognized **molecular test** (refer to Table 3)
        i. Common carbapenemase genes include KPC, NDM, OXA-48, IMP, and VIM, but other examples of carbapenemases include but are not limited to SIM, GIM, SPM, other OXA genes or novel carbapenemase genes.

ⓘ *Molecular tests for CPO identify the specific carbapenemase gene that encodes for a carbapenemase enzyme that determines the organism's mechanism of resistance. These tests will only detect gene targets available on the specified panel/probe of the assay.*

    c. Culture-independent diagnostic testing (CIDT) methods use molecular technology to detect specific gene targets in a panel
        i. CIDT lab reports may identify resistance genes that are not specific to an organism. Please reach out to the SHARP unit for consultation and assistance with following up on further lab testing.

    d. If no phenotypic or molecular testing is performed, any CPO isolate that meets the susceptibility **MIC breakpoint criteria** (refer to Table 4).

ⓘ *The MIC breakpoints detect carbapenem resistance and may indicate a potential case when other more specific tests for carbapenemases are not available.*

4. Entering Case Information into MDSS
    a. Healthcare providers reporting cases (e.g., hospital infection prevention) may consider completing the case detail form when reporting the case into MDSS.
    b. Sections to complete include the Patient Demographics, Laboratory, and Clinical Information to determine patient epidemiological information.
    c. Documentation of healthcare exposures and international travel is significantly important if available.

Local Health Departments

1. Electronic reports in MDSS
    a. Review laboratory information and available case information to determine case status/classification and follow-up case investigation.

2. Manual reporting in MDSS: Create cases from reports with healthcare records containing laboratory evidence of a Carbapenamase-producing Organism (CPO): Any **Enterobacterales** (Table 1), ***Pseudomonas aeruginosa,*** or ***Acinetobacter* spp.**, with any of the following criteria:
    a. Any isolate of CPO positive for carbapenemase production by a **phenotypic test** (refer to Table 2)

ⓘ *Phenotypic tests look for the physical characteristics of an organism. For CPO surveillance, this means looking for production of a carbapenemase enzyme that breaks down carbapenem antibiotics conferring resistance to carbapenem antibiotics.*

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    d. If no phenotypic or molecular testing is performed, any CPO isolate that meets the susceptibility **MIC breakpoint criteria** (refer to Table 4).

ⓘ *The MIC breakpoints detect carbapenem resistance and may indicate a potential case when other more specific tests for carbapenemases are not available.*

Case Status/Classification

1. LHD investigators should use the CDC/CSTE CPO Case Definition to classify cases reported to the MDSS: Carbapenemase Producing Organisms (CPO)| CDC , and CSTE position statement.

2. **Confirmed**
    a. Any **Enterobacterales** (Table 1), ***Pseudomonas aeruginosa,*** or ***Acinetobacter* spp**. specimen that meets one of the following laboratory evidence:
        - Positive phenotypic test (Table 2) result for carbapenemase production, OR
        - Positive molecular test (Table 3) result detecting a carbapenemase gene with or without organism identification, OR
        - Detection of carbapenemase gene by next generation sequencing (NGS)

3. There are no Probable or Suspect case classifications for CPO.

4. **Not a Case**
    - Organism not a CPO
    - All carbapenems are susceptible (MIC doesn't match laboratory criteria, Table 4)
    - Negative for phenotypic and molecular tests, if conducted, **regardless of MIC criteria**.

5. For additional local guidance, refer to **Appendix A: MDSS Reporting and Case Status/Classification Flowchart**

Clinical vs. Screening Case Type

1. Clinical – A clinical case is a person with a CPO identified from a clinical specimen collected **for the purpose of diagnosing or treating disease during the normal course of care.**
    - The most common examples of clinical specimens are blood, wound, urine, sputum, and tissue.
    - A CPO identified in a non-invasive site (e.g., urine) could be an indication of colonization and not true infection, however, when collected during the normal course of care it would be counted as a clinical case.

2. Screening – A screening case is a person with a CP-CRE identified in a swab collected **for the purpose of screening** regardless of the site of collection, however the most common site for CP-CRE screening is a rectal swab.

ⓘ
- These specimens are collected for the purpose of surveillance and not to identify the source of infection.
- Screening test swabs are generally only tested for the molecular resistance mechanism – genes and may not identify the organism. PCR is the preferred method for colonization screening.
- Screening is generally used for
  - Admission screening to units or facilities
  - Discharge screening
  - Point Prevalence Survey (PPS) screening
  - Screening of high-risk/epi-linked healthcare contacts to known cases (e.g., roommate or other contact identified during containment response)

Case Counting and De-duplication

1. Case Counting – **As of January 2023**, **an individual should only be counted as a CPO case once in a lifetime for the same organism and carbapenemase combination**.
   a. A specific organism/carbapenemase combination in a person should be counted as a separate case from other organism/carbapenemase combinations in the same person (e.g., KPC+ *K. pneumoniae* vs. NDM+ *E. coli*).
      - A specific organism/carbapenemase combination can include a carbapenemase gene(s) without an organism detected (e.g., NDM+ no organism vs. NDM+ *E. coli*).

   b. A person is counted as a case when a CPO is identified for the first time in a specimen, whether that be a screening or clinical specimen. If the person later has another positive specimen of the same type (i.e., both screening specimens or both clinical specimens), they are not counted again.
      - However, if a person was identified as a **screening case first and later developed clinical infection, the individual would be counted twice**: once as a screening case and once as a clinical case. **This is the only scenario that the same organism/carbapenemase combination can be counted twice for the same person.**

   c. Multiple screening positives or multiple clinical positives from the same patient, even if years apart, are not counted again if they are the same organism/carbapenemase combination. Only the first instance per patient (for an organism/carbapenemase combination) is counted. A patient who is colonized or infected with a CPO is considered to be colonized indefinitely.

2. Deduplication - All of a patient's CPO-related labs entered into MDSS can be merged into the same CPO case for a specific organism/carbapenemase combination and case type (clinical vs. screening), as appropriate, or individual cases could be closed out as "Superceded."

3. For additional details and example scenarios, refer to **Appendix B: Case Reporting and De-duplication of Investigation Status**

Case Investigation

1. Investigate all cases that fully meet the CPO case definition (**Confirmed cases**). Disease investigators may utilize the Case Detail Form in MDSS for documenting epidemiological information for CPO Cases:
    a. Complete the entire case detail form as best as possible for all CPO cases, certain targeted CPO resistance mechanisms, including **NDM-1, OXA-48, VIM, IMP or a novel mechanism, should be given higher investigation priority**.

    b. LHDs should first consider contacting the healthcare provider/hospital infection preventionist of the reporting facility to determine patient epidemiological information if not already entered in MDSS. Otherwise, proceed with case interviews.

    c. Documentation of healthcare exposures and international travel is crucially important.

    d. CPO have multiple lab components, and laboratory results electronically sent to MDSS may be staggered over a period of days (See Appendix C, Lab Reports Tab section for example).

    e. MDHHS SHARP unit may assist with providing CPO case information into MDSS as the unit is aware of reports based on existing healthcare-associated infections (HAI) collaboration with acute care and long-term care facilities for infection prevention technical assistance.
        i. LHDs may review and mark cases as "Completed" after SHARP enters case information for "Review".

    f. MDHHS SHARP unit may reach out to LHDs to request additional information based on case epidemiological information to further investigate potential clusters. For these cases, LHDs may be asked to administer an extended

questionnaire that will be provided and should be uploaded to the case Notes when completed.

2. For cases that are carbapenem-resistant according to MIC results only, and the resistance mechanism is unknown:
    a. Contact the reporting laboratory to ensure submission of the isolate to Bureau of Laboratories (BOL) for further testing. i.e., phenotype and molecular tests for carbapenemases.

    b. If the reporting laboratory has only reported interpretations for carbapenem susceptibility testing (i.e., "Resistant") without also including the MIC values, contact the laboratory to obtain a copy of the unsuppressed laboratory report.

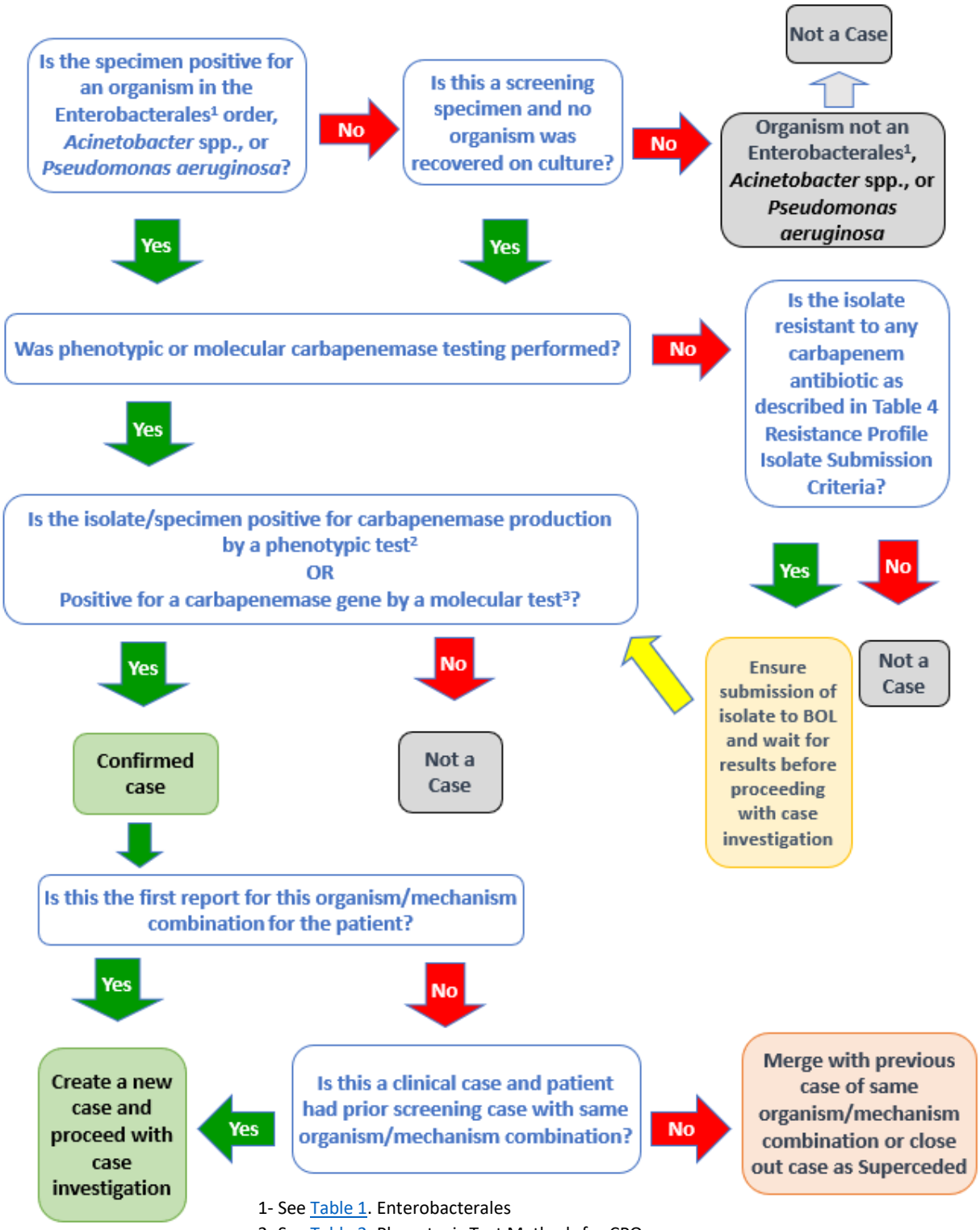
    c. Please complete the Demographics and Laboratory Testing sections of the case detail form.

    d. Completion of other epidemiological information in the case detail form is optional until further testing results are available to confirm the case.

3. For additional information on documenting details of the case investigation, see **Appendix C: MDSS Case Report Documentation**

Questions regarding CPO reporting can be directed to:
Niki Mach: MachN@michigan.gov or 517.296.6667
Sara McNamara: McNamaraS5@michigan.gov or 517.582.5645

Appendix A: MDSS Reporting and Case Status/Classification Flowchart



1- See Table 1. Enterobacterales
2- See Table 2. Phenotypic Test Methods for CPO
3- See Table 3. Molecular Test Methods for CPO

Appendix B: Case Reporting and De-duplication of Investigation Status

A person who is colonized or infected with a carbapenemase-producing organism (CPO) is considered to be colonized indefinitely. A specific organism/carbapenemase combination in a person should be evaluated and counted as a separate case from other organism/carbapenemase combinations in the same person (e.g., KPC+ *K. pneumoniae* vs. NDM+ *E. coli*). A specific organism/carbapenemase combination can include a carbapenemase gene(s) without an organism detected (e.g., NDM+ no organism vs. NDM+ *E. coli*). Any following reports of the same organism and resistance mechanism would be merged with previous cases. For more information, see updated CSTE position statement.

How to Report and Count Cases of CPO

- Evaluate each CPO organism/mechanism combination separately for each person.
- A person is counted as a case when a CPO is identified for the first time in a specimen, whether that be a screening or clinical specimen.
- If the person first had a positive screening specimen and later has another positive screening specimen, they are not counted again as a screening case.
    - However, if that person with a screening case first, later developed a positive clinical specimen, the individual would be counted twice: once as a screening case and once as a clinical case. **This is the only scenario that the same organism/carbapenemase combination can be counted twice for the same person.**
    - If that person later has additional positive screening or clinical specimens, they are not counted again (only counted twice).
- If the person first had a positive clinical specimen and later has another positive clinical or screening specimen, they are not counted again (only counted once).

Multiple screening positives or multiple clinical positives from the same patient as described above, even if years apart, are not counted again if they are the same organism/carbapenemase combination as the initial screening or clinical case, respectively (only the first instance is counted per lifetime). Below are examples of determining case investigation status for counting cases and scenarios of how to count unique clinical or screening cases.

Scenario #1 - If a person is first classified as a clinical case, and later screening reports the same organism/carbapenemase combination, they are counted only once.

Example: Patient A has a sputum culture that is positive for VIM *Pseudomonas aeruginosa*. Later, Patient A is included in a CPO screening Point Prevalence Survey (PPS) and their rectal swab is VIM positive by PCR. *P. aeruginosa* is eventually cultured from the same rectal swab

specimen. Patient A would be counted only once, as a clinical VIM+ *P. aeruginosa* case for the initial sputum culture, even if future results are positive for the same organism/carbapenemase combination from a different specimen source.

Laboratory Results	*Interpretation* →	*Action*
Sputum culture 1/12/2023 VIM+ *Pseudomonas aeruginosa*	New CPO case for Patient A, case #1	Report as a clinical case Organism: *P. aeruginosa* Gene: VIM
Rectal swab 2/13/2023 VIM+ by PCR VIM+ *P. aeruginosa* by subsequent culture	Positive screening for same organism/carbapenemase as case #1, initial clinical case. Not a new case for Patient A.	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded

Scenario #2 - A person first classified as a screening case can be later counted as a clinical case with the same organism/carbapenemase combination. **This is the only scenario that the same organism/carbapenemase combination can be counted twice for the same person**.

Example: A rectal swab from Patient A results in OXA-23+ *Acinetobacter baumannii* (CRAB). Patient A is later at a hospital where a sputum specimen tests positive for OXA-23 CRAB. Patient A would be reported as an OXA-23+ CRAB screening and later clinical case.

Laboratory Results	*Interpretation* →	*Action*
Rectal swab 1/10/2023 OXA-23+ *A. baumannii*	New CPO case #1	Report as Screening Case Organism: *A. baumannii* Gene: OXA-23
Sputum culture 3/12/2023 OXA-23+ *A. baumannii*	Positive clinical specimen for same organism/carbapenemase as case #1. New CPO case #2	Report as a Clinical Case Organism: *E. coli* Gene: KPC

Scenario #3 - A person with a known carbapenemase but unknown organism should be counted once for that carbapenemase screening when new screening reports a previously detected mechanism.

Example: Patient A's rectal swab tests positive for NDM from a PPS, but no organism was ultimately cultured from the swab. Patient A later has a urine specimen that tests positive for NDM+ *E. coli*. Another screening test shows positive for NDM. Patient A would be counted twice: once as an NDM+ screening case and once as a clinical NDM+ *E. coli* case.

Laboratory Results	*Interpretation* →	*Action*
Rectal swab 5/1/2023 NDM+ (*no organism recovered)*	New CPO case #1	Report as a Screening Case Organism: *Other, no organism identified* Gene: NDM
Urine culture 6/1/2023 NDM+ *Escherichia coli*	Positive clinical specimen for same carbapenemase, new organism. New CPO case #2	Report as a Clinical Case Organism: *E. coli* Gene: NDM
Rectal swab 9/10/2023 NDM+ (*no organism recovered)*	Positive screening for same organism/carbapenemase as case #1. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded

Scenario #4

A person with multiple screening and clinical results for a previously detected organism/carbapenemase combination is counted once for each case type.

Laboratory Results	*Interpretation* →	*Action*
Rectal swab 1/10/2023 KPC+ (*no organism recovered)*	New CPO case #1	Report as a Screening Case Organism: *Other, no organism identified* Gene: KPC
Blood culture 2/12/2023 KPC+ *Klebsiella pneumonia*	Positive clinical specimen, organism identified. New CPO case #2	Report as a Clinical Case Organism: *K. pneumonia* Gene: KPC

Rectal swab 3/10/2023 KPC+ (*no organism recovered)*	Positive screening for same carbapenemase as case #1. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded
Blood culture 3/12/2023 KPC+ *Klebsiella pneumonia*	Positive clinical specimen for same organism/carbapenemase as case #2. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #2 or close out as Superceded

Scenario #5

A person with multiple screening and clinical results for a new organism/carbapenemase combination is counted for each new occurrence.

Laboratory Results	*Interpretation* →	*Action*
Rectal swab 1/10/2023 KPC+ (*no organism recovered)*	Positive screening specimen New CPO case #1	Report as a Screening Case Organism: *Other, no organism identified* Gene: KPC
Sputum culture 2/12/2023 KPC+ *Citrobacter freundii*	Positive clinical specimen, organism identified. New CPO case #2	Report as a Clinical Case Organism: *C. freundii* Gene: KPC
Rectal swab 3/10/2023 VIM+ (*no organism recovered)*	Positive screening for new carbapenemase. New CPO case#3	Report as a Screening Case Organism: *Other, no organism identified* Gene: VIM
Blood culture 4/12/2023 KPC+ *Klebsiella oxytoca*	Positive clinical specimen for new organism/carbapenemase. New CPO case #4	Report as a Clinical Case Organism: *K. oxytoca* Gene: KPC

Scenario #6

A person with multiple organism/carbapenemases combinations identified is counted for each unique occurrence.

Laboratory Results	*Interpretation* →	*Action*
Blood culture 1/10/2023 KPC+ *Enterobacter cloacae*	Positive clinical specimen for Patient A New CPO case #1	Report as a clinical case Organism: *E. cloacae* Gene: KPC
Sputum culture 2/10/2023 VIM+ *Klebsiella aerogenes*	Positive clinical specimen for new organism/carbapenemase. New CPO case #2	Report as a clinical case Organism: *K. aerogenes* Gene: VIM
Blood culture 3/12/2023 KPC+ NDM+ *Enterobacter cloacae*	Positive clinical specimen for new carbapenemase. New CPO case #3	Report as a clinical case Organism: *E. cloacae* Gene: KPC and NDM
Urine culture 6/12/2023 KPC+ *Enterobacter cloacae*	Positive clinical specimen for same organism/carbapenemase as case #1. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded

Scenario #7

A person with more than one carbapenemase identified in the same isolate is counted once for each organism/carbapenemase combination.

Laboratory Results	*Interpretation* →	*Action*
Blood culture 3/10/2023 NDM+ OXA-48+ *Escherichia coli*	Positive clinical specimen for Patient A New CPO case #1	Report as a clinical case Organism: *E. coli* Gene: NDM and OXA-48

Respiratory culture 6/10/2023 NDM+ *E. coli*	Positive clinical specimen for new carbapenemase. New CPO case #2	Report as a clinical case Organism: *E. coli* Gene: NDM
Sputum culture 3/12/2023 NDM+ OXA-48+ *E. coli*	Positive clinical specimen for same organism/carbapenemase as case #1. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded

Scenario #8

A person with phenotypic test positive with and without genotypic testing/carbapenemase results.

Laboratory Results	*Interpretation* →	*Action*
Urine culture 3/10/2023 mCIM+ *Citrobacter koseri*	Positive clinical specimen for Patient A New CPO case #1	Report as a clinical case Organism: *C. koseri* Phenotype: mCIM, positive Gene: Not Tested
Urine culture 4/15/2023 mCIM+ NDM+ *Citrobacter koseri*	Positive clinical specimen for Patient A New CPO case #2	Report as a clinical case Organism: *C. koseri* Phenotype: mCIM, positive Gene: NDM+
Blood culture 8/10/2023 mCIM+ NDM+ *Citrobacter koseri*	Positive clinical specimen for same organism/carbapenemase as case #2. Not a new case	Enter new lab info in the Lab Reports tab and Merge with case #2 or close out as Superceded

Scenario #9

A person with phenotypic test positive, without genotypic testing/carbapenemase results.

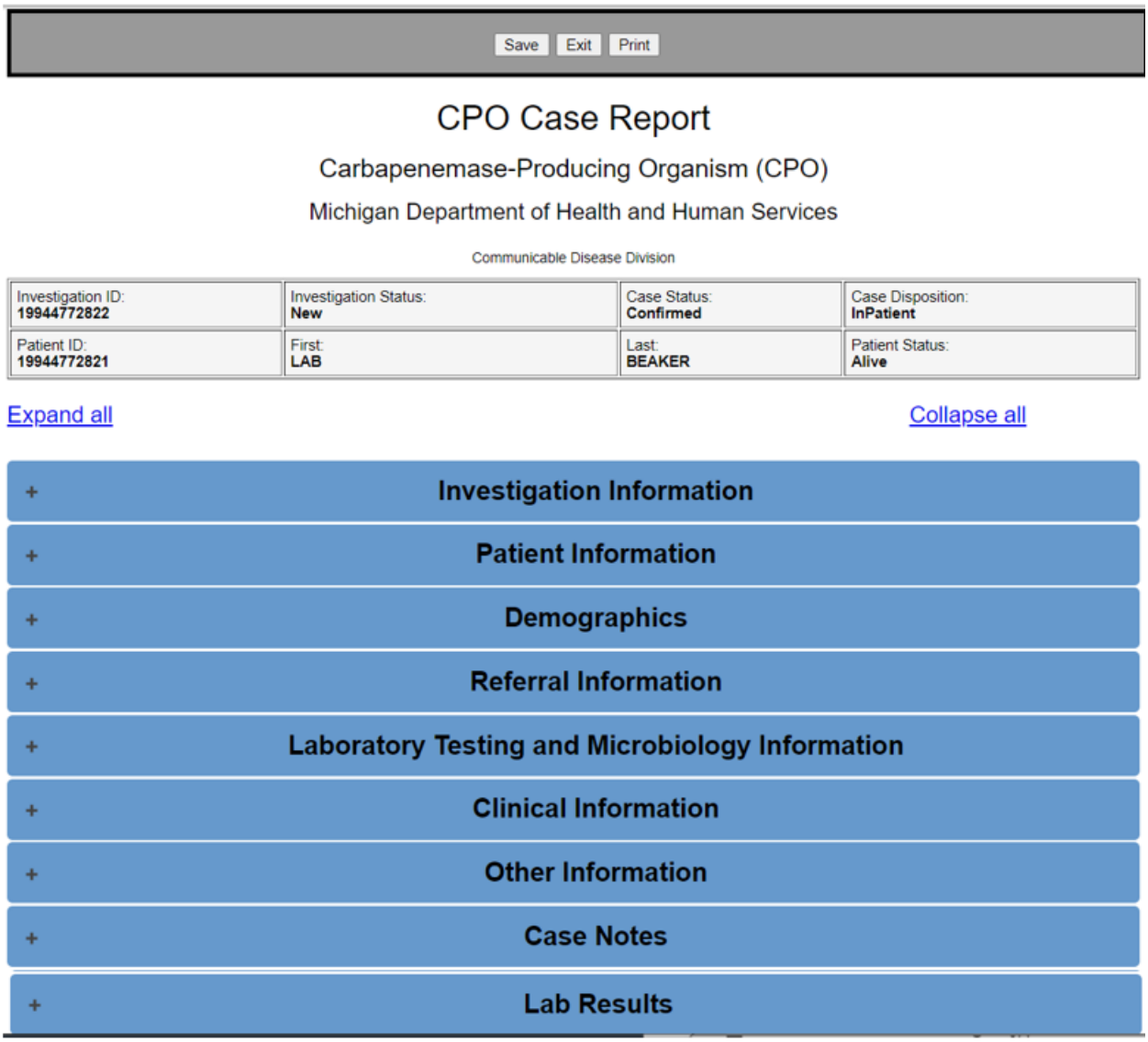
Laboratory Results	*Interpretation* →	*Action*
Wound culture 3/10/2023 mCIM+ *E. coli*	Positive clinical specimen for Patient A New CPO case #1	Report as a clinical case Organism: *E. coli* Gene: Not tested
Blood culture 8/10/2023 mCIM+ *E. coli*	Positive clinical specimen for same organism as case #1. Not a new case.	Enter new lab info in the Lab Reports tab and Merge with case #1 or close out as Superceded

Appendix C: MDSS Case Report Documentation

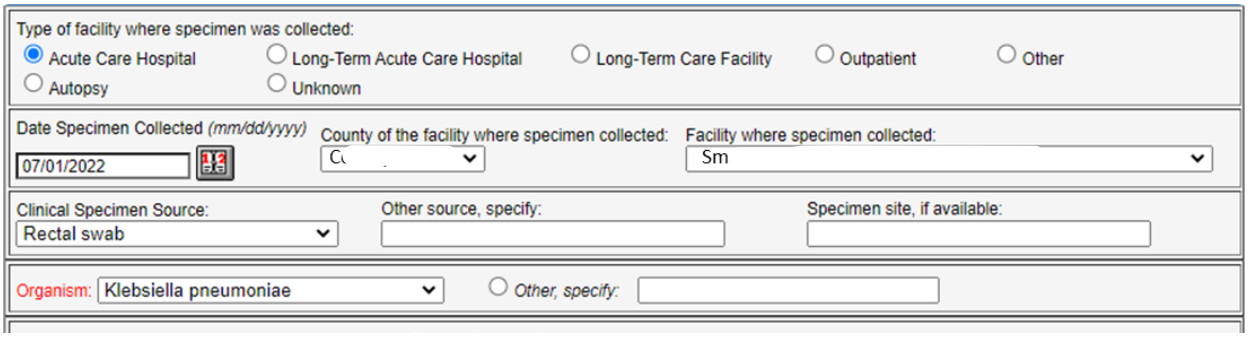
Data fields in MDSS are important to generating quality data reports for describing the epidemiology of the condition. Some highlighted sections below from the case report form explain details of documenting information in MDSS for completeness.

MDSS All Sections

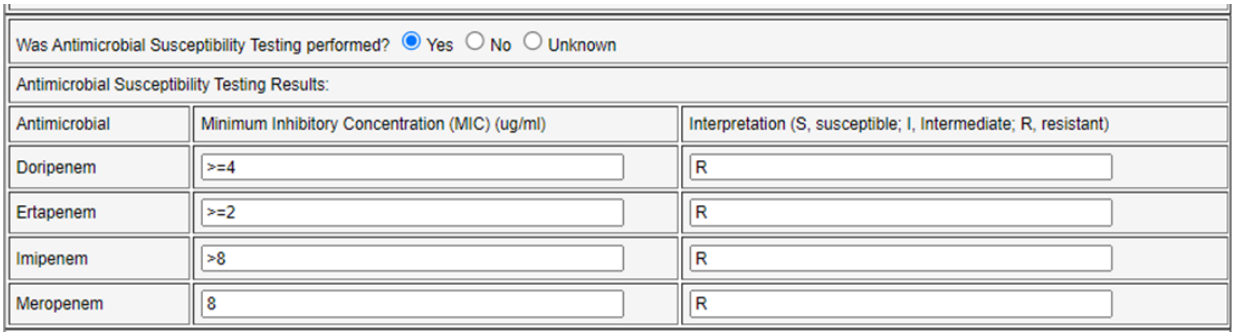
Complete the entire case detail form as best as possible, **especially for certain targeted CPO resistance mechanisms, including NDM-1, OXA-48, VIM, IMP, or any novel carbapenemases**.



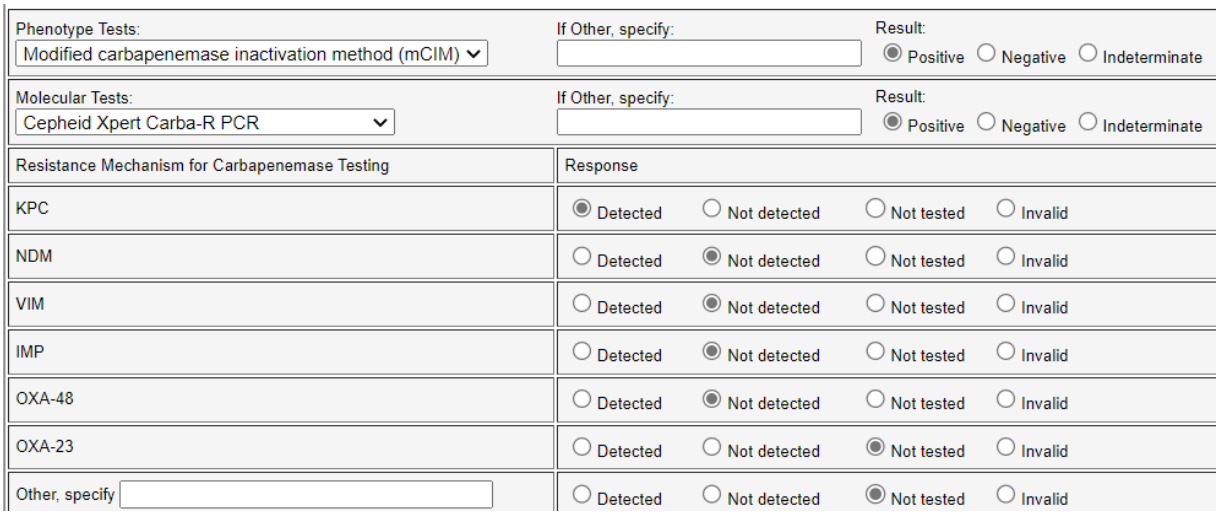
Laboratory Testing and Microbiology Information section



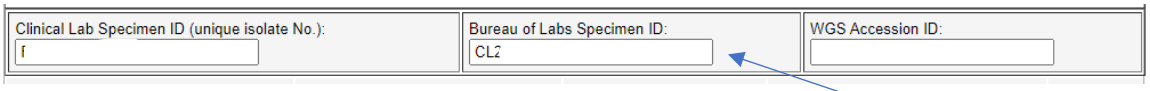
- Please complete all fields in this section with available information for facility, specimen, and organism.



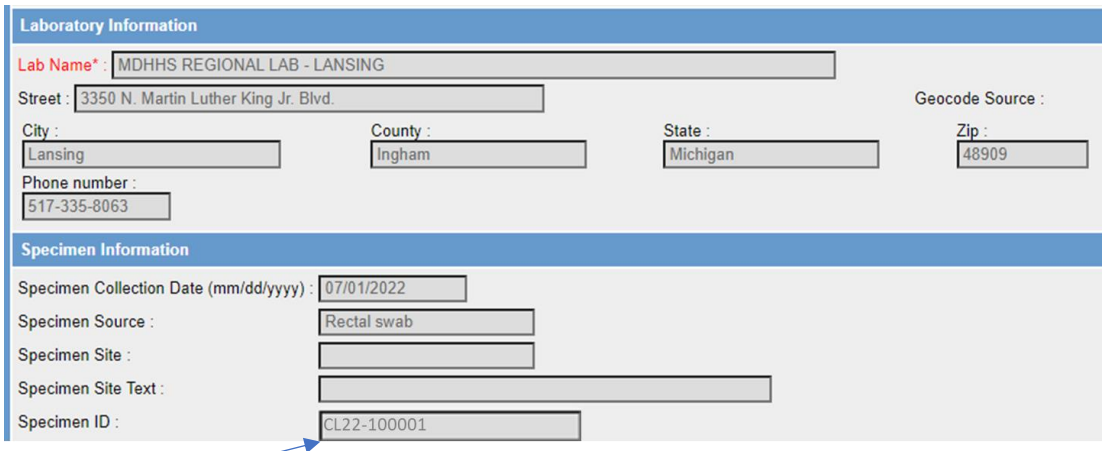
- If Antimicrobial Susceptibility Testing (AST) was performed, include AST results in the lab reports tab or upload report to notes tab.
- Entering AST information is optional:
    - Enter results as numeric values for MIC susceptibility test results
    - Enter interpretations: “R”, “S”, “I”



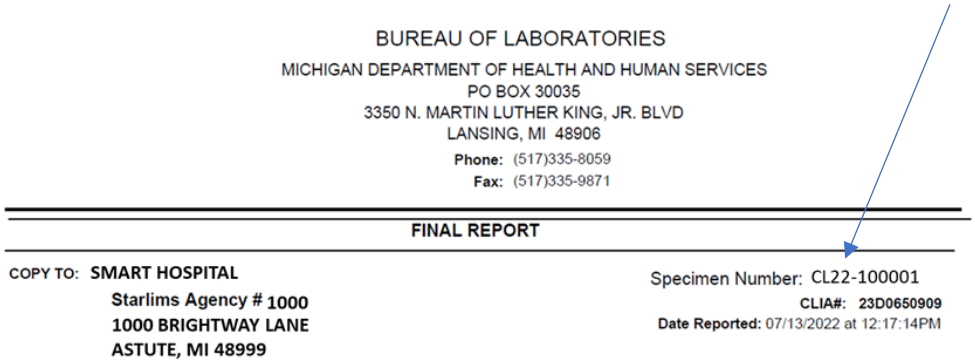
- Phenotype Tests
    - Select the test method and result: Positive, Negative, etc.
    - Select "Not Tested" if test was not available/performed
    - Note: MDHHS BOL performs the "Modified carbapenemase inactivation method (mCIM)"
- Molecular Tests
    - Select the test method and result: Positive, Negative, etc.
    - Enter response for each resistance mechanism if tested, i.e., "Detected", "Not detected", etc.
    - Note: MDHHS BOL usually uses the "Cepheid Xpert Carba-R PCR" method for KPC, NDM, OXA-48, VIM, and the "CDC Carbapenemase gene PCR" for IMP, OXA-23,24/40,58



- BOL specimen IDs should be included in the "Bureau of Labs Specimen ID" field
- The MDSS Lab Reports tab has information for the Specimen ID from the lab that performed the test: Clinical Lab or BOL



- BOL specimen ID can also be found on the top right area of the BOL report form



Lab Reports Tab

- Components of lab results may be received over multiple days despite the same collection date. E.g., specimen collection date of 11/15/2023, and various lab results were received on 11/20/2023, 12/01/23 and 12/05/2023.

Lab Reports Help

Date Received	Collection Date	Test Name (* Case Associated)	Result	Electronic	
12/05/2023	11/15/2023	Carbapenem resistance genes *	KPC (bla-KPC) gene DNA Detected	Yes	View
12/05/2023	11/15/2023	Culture Results *	Klebsiella variicola	Yes	View
12/05/2023	11/15/2023	Antimicrobial Susceptibility Results *	> 2	Yes	View
12/05/2023	11/15/2023	Modified Carbapenem Inactivation Method *	Positive	Yes	View
12/05/2023	11/15/2023	PCR Result *	KPC (bla-KPC) gene DNA Detected	Yes	View
12/05/2023	11/15/2023	IMP PCR Result *	IMP (bla-IMP) gene DNA Not Detected	Yes	View
12/01/2023	11/15/2023	PCR Result *	KPC (bla-KPC) gene DNA Detected	Yes	View
12/01/2023	11/15/2023	Culture Results *	Klebsiella variicola	Yes	View
12/01/2023	11/15/2023	Antimicrobial Susceptibility Results *	> 2	Yes	View
11/21/2023	11/15/2023	Blood Culture *	Klebsiella variicola, Carbapenem resistant	Yes	View
11/20/2023	11/15/2023	Blood Culture *	Klebsiella variicola, Carbapenem resistant	Yes	View
11/20/2023	11/15/2023	Urine Culture *	Klebsiella variicola, Carbapenem resistant	Yes	View

Lab Results

Example of a MDHHS BOL electronic lab report interpretation of Not a Case: the mCIM is negative and the Carbapenem resistance genes result only indicates the organism and not a gene that would be detected.

Lab Reports Help

Date Received	Collection Date	Test Name (* Case Associated)	Result	Electronic	
08/11/2021	07/22/2021	Culture Results	Enterobacter cloacae complex	Yes	View
08/11/2021	07/22/2021	Modified Carbapenem Inactivation Method	Negative	Yes	View
08/11/2021	07/22/2021	Carbapenem resistance genes	Enterobacter cloacae complex	Yes	View