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

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Purpose

Carbapenem-resistant Enterobacterales (CRE) and other carbapenem-resistant organisms are a significant public health concern and contribute to the growing problem of antibiotic resistance. The Enterobacterales constitute a large order of Gram-negative bacilli. They can be found in soil and water and commonly inhabit the intestine in humans and may colonize human skin and other body sites.

Carbapenem antibiotics (doripenem, ertapenem, imipenem, and meropenem) are active against many different groups of bacteria and are usually reserved for severe infections. Certain Gram-negative bacilli, including the Enterobacterales, have developed carbapenem resistance which limits options for treating infections due to 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 carbapenem-resistant Enterobacterales (CP-CRE)

Therefore, CP-CRE reporting is crucially important for identifying and limiting the spread. MDHHS continues to work with clinical laboratories to report all genera of CP-CRE electronically to the Michigan Disease Surveillance System (MDSS). However, in the interim, most CP-CRE 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 CP-CRE cases in MDSS.

Laboratory Reporting

1. Report all cases of CP-CRE with healthcare records containing a diagnosis of Carbapenamase-producing Carbapenem-resistant Enterobacterales (CP-CRE).

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*	*Wiggleworthia*
			Pseudoescherichia	*Xenorhabdus*
			Pseudocitrobacter	*Yokenella*

2. **Submit suspect or confirmed isolates**, subcultures, or specimens from the patient being tested to the MDHHS Lansing Bureau of Laboratory (BOL) according to the following criteria for the two types of carbapenemase testing (refer to Table 2):
    - Any isolate of Enterobacterales positive for **carbapenemase production by a phenotypic method**.

- Any isolate of Enterobacterales positive for a known **carbapenemase resistance mechanism by a recognized molecular test** for a carbapenemase gene.
  - 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.

Table 2. Phenotypic and Molecular Test Methods for CP-CRE

Phenotypic tests for carbapenemase production (Pos/Neg)	**Molecular tests for specific type of carbapenemase (resistance mechanism)** [3] **(e.g., KPC gene detected)**
Carba NP	BD Max Check-Points CPO
Carbapenem inactivation method (CIM)	FilmArray (BioFire)
EDTA-modified CIM (eCIM)	Nucleic acid amplification test (NAAT) (e.g., PCR)
Immunochromatography test (ICT) [1] including the NG-Test Carba 5	Streck ARM-D
Metallo-β-lactamase test (e.g., E-test)	Verigene Gram-Negative Blood
Modified carbapenem inactivation method (mCIM)	Culture Nucleic Acid Test (BC-GN)
Modified Hodge test (MHT) [2]	Whole-genome sequencing (WGS)
	Xpert Carba-R

[1] ICT is a phenotypic test that can identify a specific enzyme (carbapenemase).
[2] The Modified Hodge Test is no longer included in CLSI guidelines and should only be used in conjunction with other phenotypic or molecular tests for carbapenemases.
[3] 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.

3. If laboratories are unable to detect CP-CRE, (i.e., cannot test for carbapenemase production or carbapenemase resistance mechanism) and only perform susceptibility testing:
   - Submit isolate of Enterobacterales that is resistant to any one of the carbapenem antibiotic based on **minimum inhibitory concentration (MIC)** breakpoints.

Table 3. Carbapenem Susceptibility Testing

Report CP-CRE for any one of the following carbapenem MIC criteria:	
Doripenem	≥ 4 mcg/ml
Ertapenem	≥ 2 mcg/ml
Imipenem	≥ 4 mcg/ml
Meropenem	≥ 4 mcg/ml

Report based on MIC numeric criteria (e.g., ≥4 mcg/ml), not on interpretation alone (i.e., “Resistant”, “Susceptible”, “Intermediate”)

Infection Prevention Reporting

1. Following identification of suspect CP-CRE, 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 healthcare records containing a diagnosis of Carbapenamase-producing Carbapenem-resistant Enterobacterales (CP-CRE) (refer to Table 1) with the following criteria:
    a. Any isolate of Enterobacterales positive for carbapenemase production by a **phenotypic test** (refer to Table 2)

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

    b. Any isolate of Enterobacterales with a known carbapenemase resistance mechanism by a recognized **molecular test** (refer to Table 2)
        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 CP-CRE 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 Enterobacterales isolate that meets the susceptibility **MIC breakpoint criteria** for any one carbapenem antibiotic (refer to Table 3).

ⓘ *The MIC breakpoints detect carbapenem resistance and may indicate a suspect 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 a diagnosis of Carbapenamase-producing Carbapenem-resistant Enterobacterales (CP-CRE) (refer to Table 1) with the following criteria:
    a. Any isolate of Enterobacterales positive for carbapenemase production by a **phenotypic test** (refer to Table 2)

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

    b. Any isolate of Enterobacterales with a known carbapenemase resistance mechanism by a recognized **molecular test** (refer to Table 2)
        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 CP-CRE 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 Enterobacterales isolate that meets the susceptibility **MIC breakpoint criteria** for any one carbapenem antibiotic (refer to Table 3).

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

Case Status/Classification

1. LHD investigators should use the CDC/CSTE CP-CRE Case Definition to classify cases reported to the MDSS: Carbapenemase Producing Carbapenem-Resistant Enterobacteriaceae (CP-CRE)| CDC , and updated CSTE position statement.
2. **Confirmed CP-CRE**
   - ✓ *Enterobacterales* organism (refer to Table 1) or no organism recovered from a molecular carbapenemase screening specimen
   - ✓ Positive phenotypic test (e.g., mCIM, Carba NP, etc.; refer to Table 2) **OR**
   - ✓ Positive molecular test (e.g., PCR, Cepheid Xpert, etc.; refer to Table 2) – carbapenem resistance mechanism: KPC, NDM, VIM, IMP, OXA-48, etc.
3. **Suspect CP-CRE**
   - ✓ *Enterobacterales* organism (refer to Table 1)
   - ✓ Resistance to at least one carbapenem on susceptibility testing (refer to MIC criteria in Table 3)
   - ✓ No phenotypic or molecular testing done (isolate should be submitted to BOL)
4. **Not a Case**
   - ✓ Organism not *Enterobacterales* (refer to Table 1)
   - ✓ All carbapenems are susceptible (MIC don't match case definition in Table 3)
   - ✓ Negative for phenotypic and molecular tests, if conducted, regardless of MIC criteria in Table 3.
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 CP-CRE 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 CP-CRE 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

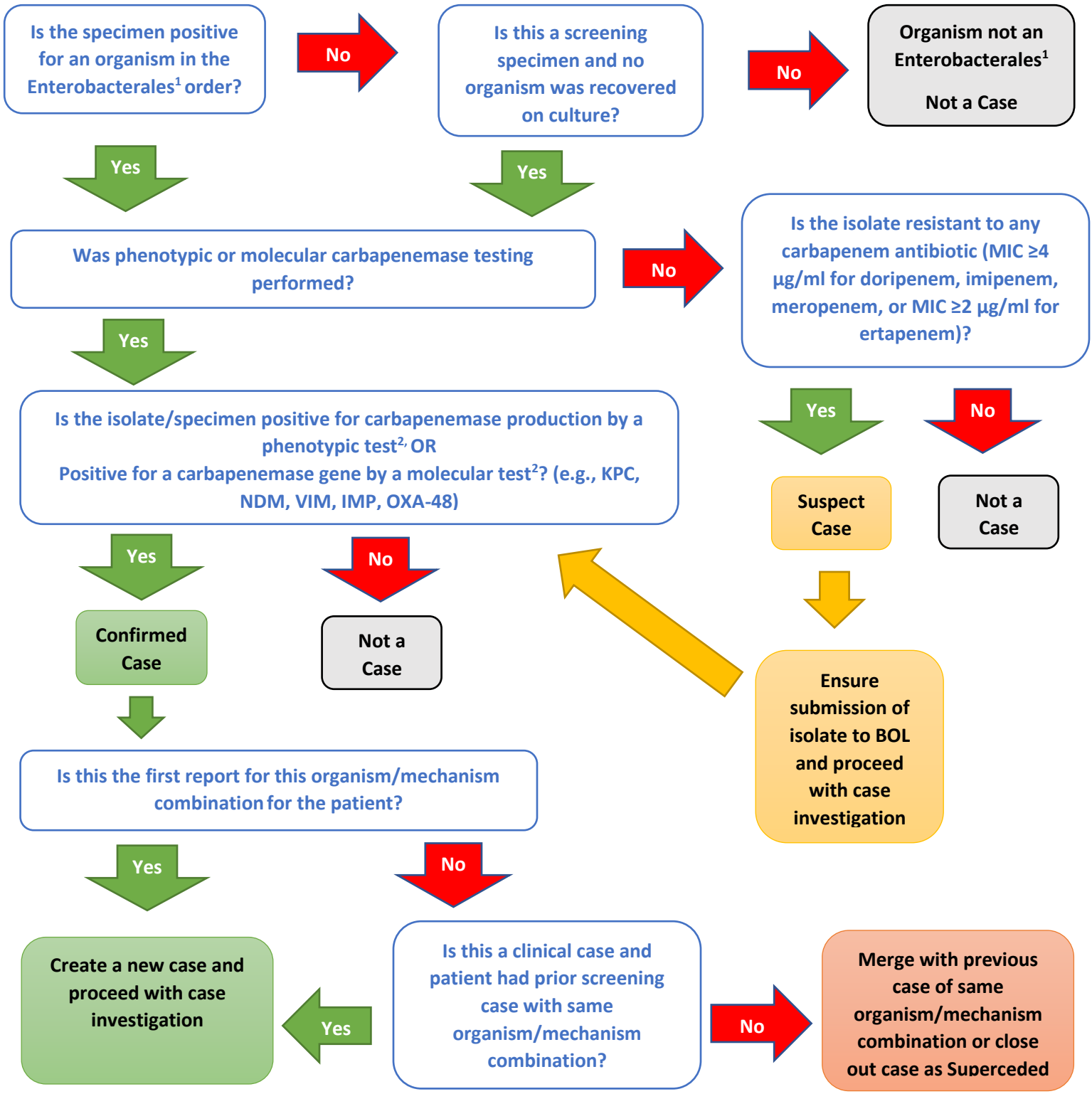
1. Case Counting - **Beginning in January 2023**, **an individual should only be counted as a CP-CRE case once in a lifetime for the same organism and carbapenemase combination**.
   a. A specific organism/carbapenemase combination in a person should be counted as a separate case from other organism/carbapenemase 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 CP-CRE 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.
   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 CP-CRE is considered to be colonized indefinitely.
2. Deduplication - All of a patient's CP-CRE-related labs entered into MDSS can be merged into the same CP-CRE 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 CP-CRE case definition (**Confirmed cases**). Disease investigators may utilize the Case Detail Form in MDSS for documenting epidemiological information for CP-CRE Cases:
    a. Complete the entire case detail form as best as possible, especially for certain targeted CP-CRE resistance mechanisms, including NDM-1, OXA-48, VIM, IMP or a novel mechanism.
    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. 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, but the resistance mechanism is unknown (**Suspect cases**):
    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.
3. For additional information on documenting details of the case investigation, see **Appendix C: MDSS Case Report Documentation**

Questions regarding CP-CRE reporting can be directed to:
Niki Mach: MachN@michigan.gov or 517.290.6667
Sara McNamara: McNamaraS5@michigan.gov or 517.582.5645

Appendix A: MDSS Reporting and Case Status/Classification Flowchart



1- See Table 1. Enterobacterales, all genera

2- See Table 2. Phenotypic and Molecular Test Methods for CP-CRE

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

Beginning in January 2023, an individual should only be counted as a Carbapenem Producing Carbapenem-resistant Enterobacterales (CP-CRE) case once in a lifetime for the same organism and resistance mechanism. Any following reports of the same organism and resistance mechanism would be merged with previous cases. See updated CSTE position statement.

Below are examples of determining case investigation status for counting cases and scenarios of how to count unique clinical or screening cases. Color legend: Blue is screening specimen, Peach is clinical specimen, Green is reporting, Pink is duplicate case information.

How to Report and Count Cases of CP-CRE

A person is counted as a case when a carbapenemase-producing organism (CP-CRE) is identified for the first time in a specimen, whether that be a screening or clinical specimen.

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 KPC *K. pneumoniae*. Later, Patient A is included in a CP-CRE screening Point Prevalence Survey (PPS) and their rectal swab is KPC positive by PCR. *K. pneumoniae* is eventually cultured from the same rectal swab specimen. Patient A would be counted only once, as a clinical KPC+ *K. pneumoniae* 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 KPC+ K*lebsiella pneumoniae*	New CP-CRE case for Patient A, case #1	Report as a clinical case Organism: *K. pneumoniae* Gene: KPC
Rectal swab 2/13/2023 KPC+ by PCR KPC+ *Klebsiella pneumoniae* 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 KPC+ *E. coli*. Patient A is later at a hospital where a blood specimen tests positive for KPC *E. coli*. Patient A would be reported as a KPC+ *E. coli* screening and clinical case.

Laboratory Results	*Interpretation* →	*Action*
Rectal swab 1/10/2023 KPC+ *Escherichia coli*	New CP-CRE case #1	Report as Screening Case Organism: *E. coli* Gene: KPC
Blood culture 2/12/2023 KPC+ Escherichia coli	Positive clinical specimen for same organism/carbapenemase as case #1. New CP-CRE 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 CP-CRE case #1	Report as a Screening Case Organism: *Other Enterobacterales, no organism identified* Gene: NDM
Urine culture 6/1/2023 NDM+ *Escherichia coli*	Positive clinical specimen for same carbapenemase, new organism. New CP-CRE 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 CP-CRE case #1	Report as a Screening Case Organism: *Other Enterobacterales, no organism identified* Gene: KPC
Blood culture 2/12/2023 KPC+ *Klebsiella pneumonia*	Positive clinical specimen, organism identified. New CP-CRE 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 CP-CRE case #1	Report as a Screening Case Organism: *Other Enterobacterales, no organism identified* Gene: KPC
Sputum culture 2/12/2023 KPC+ *Citrobacter freundii*	Positive clinical specimen, organism identified. New CP-CRE 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 CP-CRE case#3	Report as a Screening Case Organism: *Other Enterobacterales, no organism identified* Gene: VIM
Blood culture 4/12/2023 KPC+ *Klebsiella oxytoca*	Positive clinical specimen for new organism/carbapenemase. New CP-CRE 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 CP-CRE 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 CP-CRE 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 CP-CRE 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 CP-CRE 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 CP-CRE 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 CP-CRE 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 CP-CRE 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.

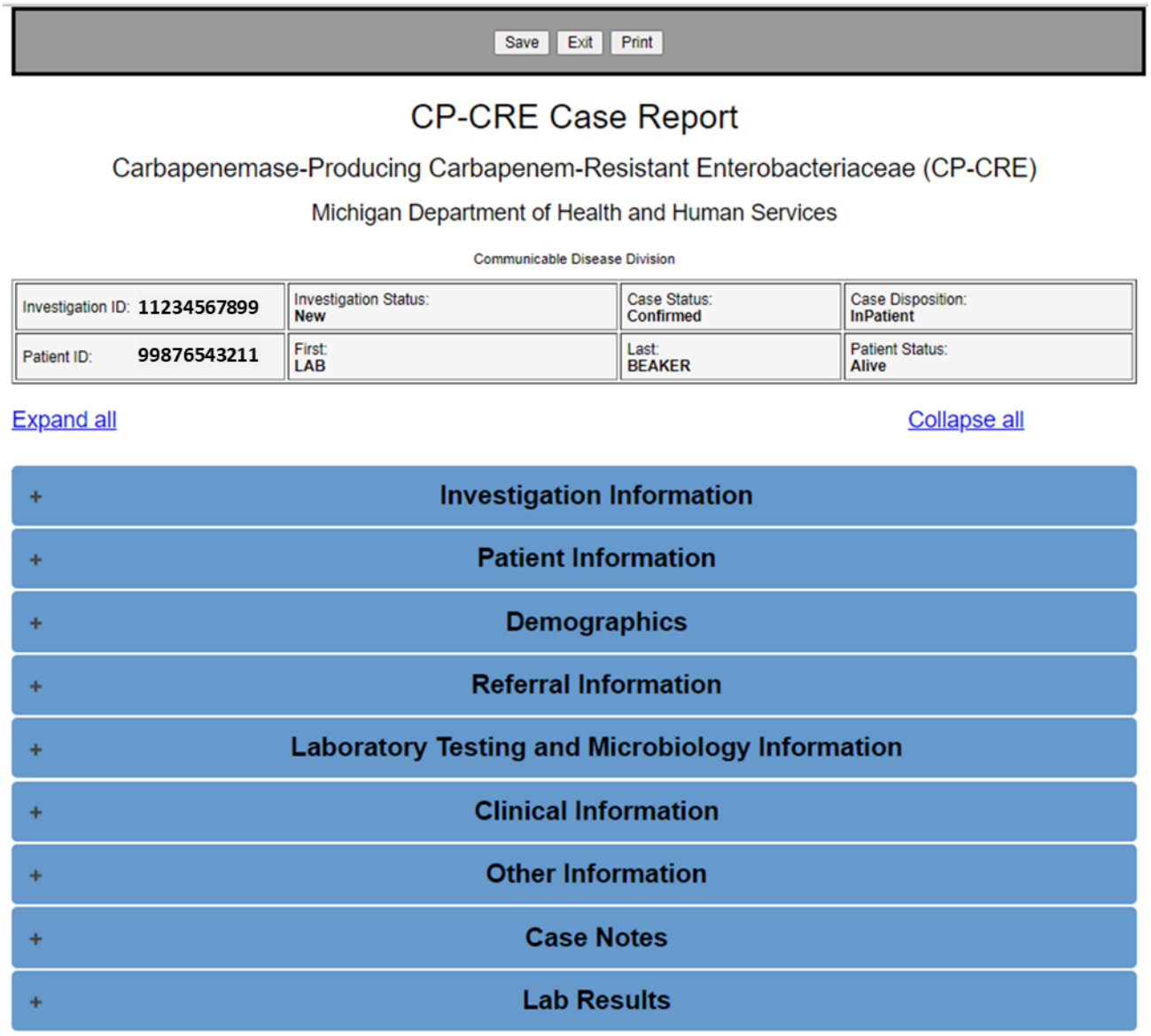
Laboratory Results	*Interpretation*	*Action*
Wound culture 3/10/2023 mCIM+ *E. coli*	Positive clinical specimen for Patient A New CP-CRE case #1	Report as a clinical case Organism: *E. coli* Gene: Not tested
Blood culture 8/10/2023 mCIM+ *E. coli*	Positive clinical specimen for same organism as case #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.

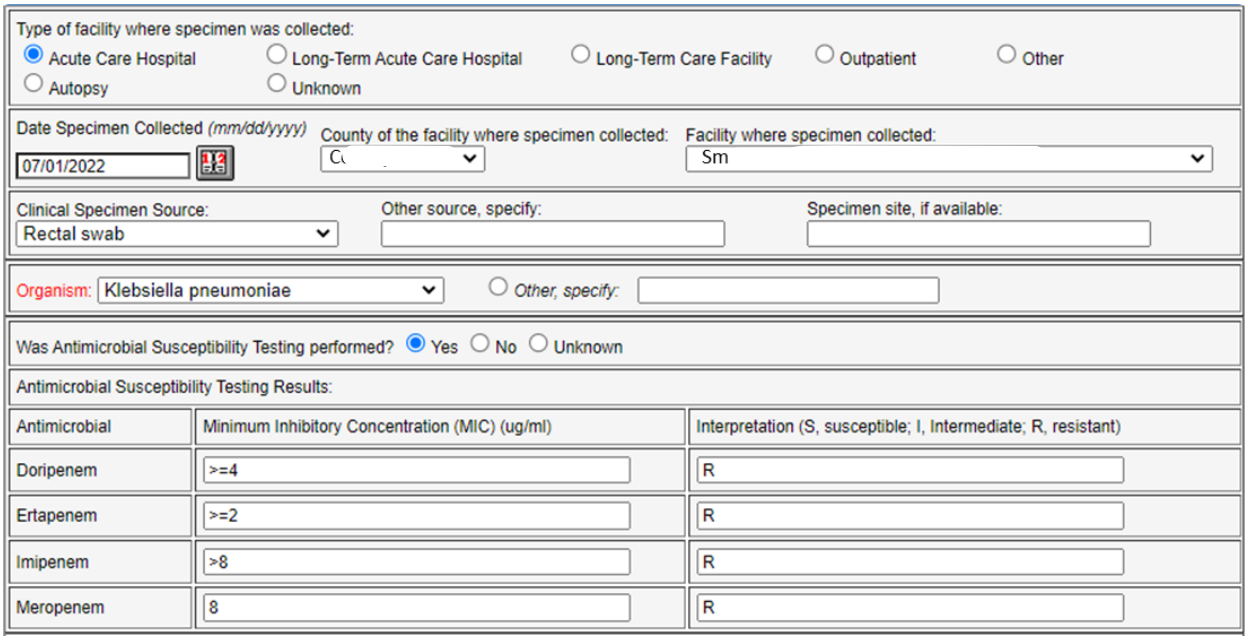
MDSS All Sections

Complete the entire case detail form as best as possible, especially for certain targeted CP-CRE 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



Type of facility where specimen was collected:
(●) Acute Care Hospital ( ) Long-Term Acute Care Hospital ( ) Long-Term Care Facility ( ) Outpatient ( ) Other
( ) Autopsy ( ) Unknown

Date Specimen Collected *(mm/dd/yyyy)*: 07/01/2022 | County of the facility where specimen collected: C | Facility where specimen collected: Sm

Clinical Specimen Source: Rectal swab | Other source, specify: | Specimen site, if available:

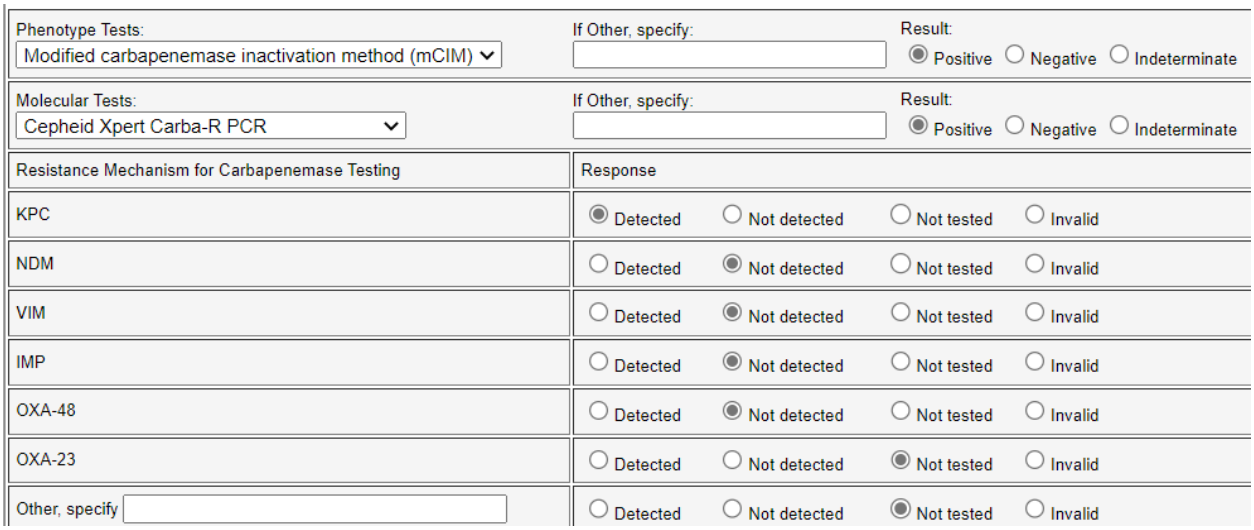
Organism: Klebsiella pneumoniae | ( ) *Other, specify:*

Was Antimicrobial Susceptibility Testing performed? (●) Yes ( ) No ( ) Unknown

Antimicrobial Susceptibility Testing Results:

Antimicrobial	Minimum Inhibitory Concentration (MIC) (ug/ml)	Interpretation (S, susceptible; I, Intermediate; R, resistant)
Doripenem	>=4	R
Ertapenem	>=2	R
Imipenem	>8	R
Meropenem	8	R

- Enter numeric values for MIC susceptibility test results
- Enter interpretations: “R”, “S”, “I”



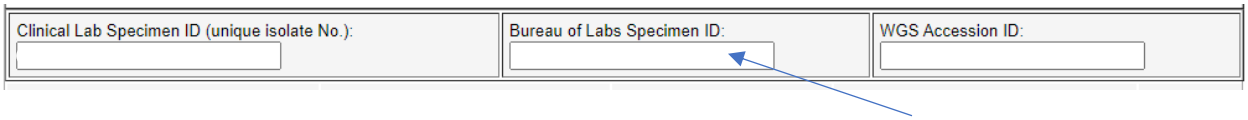
Phenotype Tests: Modified carbapenemase inactivation method (mCIM) | If Other, specify: | Result: (●) Positive ( ) Negative ( ) Indeterminate

Molecular Tests: Cepheid Xpert Carba-R PCR | If Other, specify: | Result: (●) Positive ( ) Negative ( ) Indeterminate

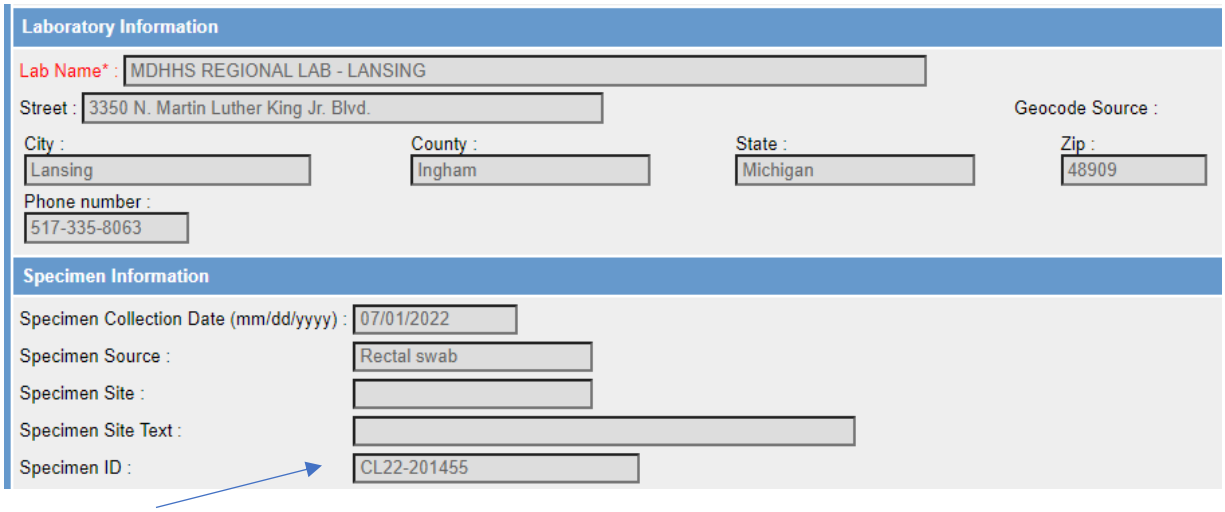
Resistance Mechanism for Carbapenemase Testing	Response
KPC	(●) Detected ( ) Not detected ( ) Not tested ( ) Invalid
NDM	( ) Detected (●) Not detected ( ) Not tested ( ) Invalid
VIM	( ) Detected (●) Not detected ( ) Not tested ( ) Invalid
IMP	( ) Detected (●) Not detected ( ) Not tested ( ) Invalid
OXA-48	( ) Detected (●) Not detected ( ) Not tested ( ) Invalid
OXA-23	( ) Detected ( ) Not detected (●) Not tested ( ) Invalid
Other, specify	( ) Detected ( ) Not detected (●) Not tested ( ) Invalid

- 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