Global Action in Healthcare Network Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Containment Activities

This guidance is intended for global healthcare settings participating in GAIHN-AR.

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Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

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Contents

Glossary

Antimicrobial-resistant organisms: Some bacteria and fungi are naturally (intrinsically) resistant to certain antimicrobials. For the purposes of this document, this term refers to bacteria that are resistant to one or more classes of antimicrobials to which they are usually susceptible.

Broad phenotypic carbapenemase production testing: Laboratory testing that detects carbapenemase activity. Examples of phenotypic testing methods include the modified carbapenem inactivation method (mCIM), Blue Carba, and Carba NP. These methods cannot identify specific carbapenemase genes/enzymes but may be useful, particularly in areas of low carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE) prevalence, to reduce the number of carbapenem-resistant Enterobacterales (CRE) isolates requiring carbapenemase gene or enzyme identification testing and inform infection prevention and control (IPC) actions.

Carbapenem-resistant organisms (CROs): Gram-negative bacteria, such as Enterobacterales, *Pseudomonas aeruginosa*, and *Acinetobacter baumannii*, that test resistant to at least one carbapenem against which they are not intrinsically resistant.

Carbapenemases: Types of beta-lactamase enzymes that can hydrolyze penicillins, cephalosporins, and carbapenem antibiotics. Bacteria that produce carbapenemases can cause difficult-to-treat infections. Carbapenemase genes, which encode these enzymes, are often carried on mobile genetic elements, such as plasmids, and have the potential for rapid spread in healthcare settings.

Carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE): Enterobacterales that test resistant to at least one carbapenem antibiotic and produce or carry genes that encode at least one carbapenemase. CP-CRE are associated with high levels of antimicrobial resistance and difficult-to-treat infections. For more information about CP-CRE, visit https://www.cdc.gov/hai/organisms/cre/technical-info.html.

Carbapenemase-producing organisms (CPOs): Organisms that produce or carry a gene that encodes a carbapenemase.

Clinical culture: Clinical cultures are collected as part of routine patient care (e.g., blood culture, urine culture, etc.). For public health purposes, identification of antimicrobial-resistant organisms such as CP-CRE allows for the implementation of appropriate IPC actions and for the detection of carbapenemases for which containment strategies should apply. In some cases, the patient may be asymptomatically colonized with an antimicrobial-resistant organism (e.g., finding CP-CRE in urine culture obtained from an asymptomatic patient); however, infection control actions such as initiating Contact Precautions or containment (if appropriate) should still be pursued due to the risk of transmission to other patients.

Colonization: Colonization means that the organism can be found in or on the body but it is not causing any symptoms or disease.

Colonization screening: The use of laboratory testing to determine if a patient is asymptomatically colonized (i.e., a carrier) with antimicrobial-resistant organisms such as CP-CRE to enact appropriate IPC actions during their care to limit transmission to others.

Contact: For the purpose of this document, refers to a patient who is currently or was previously housed on the same unit in a healthcare facility as the index patient.

Contact screening: A type of colonization screening used during a containment response. Colonization screening of contacts identifies unrecognized, asymptomatic carriers allowing for rapid implementation of IPC measures to limit the spread of the organism.

Confirmed novel or non-targeted carbapenemase: A carbapenemase that has never been detected or is not one of the targeted carbapenemases (*Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo-beta-lactamase (NDM), Verona Integron-encoded metallo-beta-lactamase (VIM), Imipenemase metallo-beta-lactamase (IMP), and oxacillinase (OXA)-48-like) and is unusual for the healthcare facility. Identification of a novel carbapenemase requires the use of whole genome sequencing (WGS), and non-targeted carbapenemases may be confirmed by PCR or WGS. The epidemiological understanding of novel carbapenemases and some non-targeted carbapenemases is unclear (e.g., populations at risk, modes of transmission, etc.) and will require Tier 1 containment response.

Contact Precautions: Contact Precautions are actions intended to prevent transmission of infectious agents, including CP-CRE, that are spread by direct or indirect contact with infected or colonized patients or the patients' environment. A single-patient room is preferred for those who require Contact Precautions. In multi-patient rooms, ≥1-meter spatial separation between beds is advised to reduce the opportunities for inadvertent sharing of items between the infected/colonized patient and other patients. When healthcare workers are caring for patients on Contact Precautions, a gown and gloves should be worn for all interactions involving contact with the patient and the patient's environment. The use of dedicated patient equipment is also recommended; however, when this is not possible, shared equipment should be cleaned and disinfected immediately after each use. High-touch surfaces in rooms or areas housing patients on Contact Precautions should be cleaned and disinfected at least twice daily. Additionally, the transport of patients outside of their room on Contact Precautions should be limited to medically necessary purposes.

Containment response: Activities described in this guidance that are implemented in response to detecting a single antimicrobial-resistant threat. While containment can be used for various antimicrobial-resistant organisms, GAIHN-AR currently focuses on implementing a containment response for CP-CRE containing a novel carbapenemase or a rare targeted or non-targeted carbapenemase.

Healthcare facility (HCF): In this document, refers to the hospital setting.

Healthcare facility unit: In this document, refers to an area that houses a group of patients that have similar care needs (e.g., medical, surgical, intensive care) but can be arranged in different configurations ranging from patients in a single room, multiple patients in multiple rooms, to one large room housing all patients.

High-risk for antimicrobial-resistant organisms: Refers to patient risk factors that place them at higher risk for becoming colonized and infected with an antimicrobial-resistant organism such as CP-CRE compared to other patients. These risk factors can include but are not limited to being critically ill, immunosuppressed, receiving broad-spectrum antibiotics, requiring high levels of care (e.g., bed bound), or requiring invasive devices (e.g., ventilators, urinary catheters, central lines, etc.).

High-risk units: Units that are not designated as a targeted prevention unit but for which the risk of CP-CRE transmission is higher due to factors such as (but not limited to) caring for patients at high risk for CP-CRE acquisition (e.g., bed bound, mechanically ventilated, immunosuppressed, etc.), having a history of past antimicrobial-resistant organism transmission, or frequently sharing patients with other high-risk units.

Index patient: The initial patient infected or colonized with the Tier 1 or Tier 2 organism that led to the initiation of the containment response. If multiple patients were reported before initiation of the containment response, then the patient with the earliest specimen collection date is considered the index patient.

Molecular/enzymatic carbapenemase identification: Laboratory testing methods such as polymerase chain reaction (PCR) or immunochromatography that aim to identify five specific targeted carbapenemase genes/enzymes: KPC, NDM, VIM, IMP, and OXA-48-like.

Non-targeted carbapenemase: A carbapenemase other than KPC, NDM, IMP, VIM and OXA-48-like. Non-targeted carbapenemase genes may be detected by supplemental PCR, if available, or may require WGS.

Pan-resistant organisms: In this guidance, a pan-resistant organism is resistant to all relevant antimicrobials tested at the clinical laboratory that serves the HCF. Relevant antimicrobials for CP-CRE are those that have activity against Enterobacterales and are available for treatment in the HCF. Confirmation of pan-resistance and additional characterization by a reference laboratory is recommended for all potentially pan-resistant organisms.

Point prevalence survey (PPS): Colonization screening of all patients admitted at the time of the survey to the HCF or unit.

Prevention activities: Continuous and on-going activities such as infection prevention and control (IPC) assessments, IPC practice monitoring (auditing), and colonization screening including admission and routine surveillance screening that are used to limit the transmission of antimicrobial-resistant organisms within a facility and, unlike containment, are not deployed specifically in response to the identification of a patient with CP-CRE.

Priority organisms: Priority CRE organisms for GAIHN-AR include ***Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Klebsiella* (formerly *Enterobacter*) *aerogenes*, *and Enterobacter* spp**. (If species cannot be obtained in some of the isolates, use the genus). HCFs may target additional CROs as desired, according to local epidemiology and resources available.

Response tier: CP-CRE classification system (Tier 1, Tier 2, non-Tier 1 or 2) based on how novel or rare a carbapenemase is within a HCF. Each HCF in the GAIHN-AR network that plans to use containment for CP-CRE should develop a tailored classification system based upon their own local epidemiology.

Suspected novel or non-targeted carbapenemase: Isolates that test positive for carbapenemase production using a phenotypic test method (e.g., mCIM) but test negative for ALL targeted carbapenemases (including at least KPC, NDM, VIM, IMP, and OXA-48-like), may harbor a novel or non-targeted carbapenemase gene. Novel carbapenemase genes are only detectable through WGS.

Targeted carbapenemases: In this document, carbapenemases of interest for GAIHN-AR include KPC, NDM, VIM, IMP, and OXA-48-like for which ample epidemiological information is currently known. Targeted carbapenemases may also include others that are of local and/or national importance.

Targeted prevention unit (TPU): A unit within an HCF with a higher likelihood of antimicrobial-resistant organism transmission due to care of many patients at higher risk for antimicrobial-resistant organism acquisition and/or transmission (e.g., multiple invasive devices, prolonged lengths of stay, etc.) such as intensive care units or units with a previous history of antimicrobial-resistant organism outbreaks.

Acronyms

Acronym	Definition
CDC	U.S. Centers for Disease Control and Prevention
CLSI	Clinical and Laboratory Standards Institute
CP-CRE	Carbapenemase-producing carbapenem-resistant Enterobacterales
EUCAST	European Committee on Antimicrobial Susceptibility Testing
GAIHN-AR	Global Action in Healthcare Network-Antimicrobial Resistance Module
HCF	Healthcare Facility
HCW	Healthcare Worker
ICT	Immunochromatography Test
IMP	Imipenemase metallo-β-lactamase
IPC	Infection Prevention and Control
KPC	*Klebsiella pneumoniae* carbapenemase
NDM	New Delhi metallo-β-lactamase
OXA	Oxacillinase
PCR	Polymerase Chain Reaction
PPE	Personal Protective Equipment
PPS	Point Prevalence Survey
TPU	Targeted Prevention Unit
VIM	Verona Integron-encoded metallo-β-lactamase
WGS	Whole Genome Sequencing
WHO	World Health Organization

Introduction

The dissemination of antimicrobial-resistant organisms is a global public health problem and coordinated prevention and response efforts are critical whether the antimicrobial-resistant organism is rarely identified or is already endemic in a healthcare facility (HCF) or country[1]. Containment is a form of response to the laboratory identification of a **single novel or rarely identified carbapenemase** to slow its transmission within healthcare settings. This interim guidance summarizes suggested containment activities while other non-containment, prevention activities are highlighted in the document, "Global Action in Healthcare Network - Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Prevention Activities."

The Global Action in Healthcare Network—Antimicrobial Resistance Module (GAIHN-AR) utilizes a tiered approach for containment activities, adapted from the U.S. Centers for Disease Control and Prevention (CDC) guidance[2], which includes laboratory surveillance of clinical isolates, infection prevention and control (IPC) assessments, contact screening of index patient contacts, coordination within and between healthcare facilities (HCFs), and continued surveillance and intervention until transmission is halted or declines. This document provides considerations for activity prioritization based on available resources in the participating countries and is not intended to describe all the actions that might be required for an outbreak response (e.g., when there is sustained transmission within an HCF or region). **HCFs may need to tailor this protocol based upon their local resources and priorities.** Revisions to this document by CDC's GAIHN-AR team will be made based on lessons learned from implementing facilities and partners.

Initial priority organisms and carbapenemases

While the principles of containment can be used for a variety of antimicrobial-resistant organisms, GAIHN-AR's initial priority organisms for containment activities include ***Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, *Klebsiella* (formerly *Enterobacter*) *aerogenes*, *and Enterobacter* spp**. (If species cannot be obtained in some of the isolates, use the genus) that are resistant[3,4] to at least one carbapenem (imipenem, meropenem, doripenem, or ertapenem) and meet one of the following criteria:

1. Isolates that produce or carry a gene(s) encoding one or more of the targeted carbapenemases (KPC, NDM, VIM, IMP, OXA-48-like) and are never or rarely found in the HCF
2. Isolates with a targeted carbapenemase (KPC, NDM, VIM, IMP, OXA-48-like) which is commonly detected in a HCF and have or develop pan-resistance
3. Isolates suspected to harbor novel or non-targeted carbapenemase genes or variants that test positive for phenotypic carbapenemase production[5] but negative for all targeted carbapenemases, including at least KPC, NDM, VIM, IMP, and OXA-48-like
4. Isolates with confirmed novel or non-targeted carbapenemase genes or variants as identified by WGS

HCFs may include additional CROs and/or carbapenemase targets as desired, according to local epidemiology and resources available.

[1] Grundmann H, et al. Carbapenem non-susceptible Enterobacteriaceae in Europe: conclusions from a meeting of national experts. Euro Surveil. 2010;15:19711.
[2] CDC. Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs) https://www.cdc.gov/hai/mdro-guides/containment-strategy.html
[3] Laboratories should target Enterobacterales that test resistant to at least one carbapenem using Clinical and Laboratory Standards Institute (CLSI) or the European Committee on Antimicrobial Susceptibility Testing (EUCAST) carbapenem breakpoints.
[4] Isolates harboring weak carbapenemase gene variants, e.g., OXA-48-like, may exhibit intermediate or susceptible carbapenem antimicrobial susceptibility testing results. If weaker carbapenemases are suspected or detected, facilities may decide to perform phenotypic carbapenemase detection testing on carbapenem-intermediate or -susceptible Enterobacterales.
[5] Refer to the Global Action in Healthcare Network – Antimicrobial Resistance Module (GAIHN-AR) Interim Laboratory Guidance for Clinical Culture of Carbapenem Resistant Enterobacterales for further information.

Containment response tiers

HCF should review their currently available CP-CRE laboratory data and, based upon the frequency of resistance mechanism detection, local epidemiology, and agreement with other collaborating partners, assign each of the GAIHN-AR targeted carbapenemases (i.e., KPC, NDM, VIM, IMP, OXA-48 like) into one of three Containment Tiers: Tier 1, Tier 2, and non-Tier 1 or 2 (Table 1 below). For facilities without pre-existing CP-CRE data, tier assignment will be dependent upon establishing consistent access and use of clinical cultures and colonization screening to better define the current epidemiology. With increased laboratory testing over time, tier reassignments of the targeted carbapenemases will likely be required. Tier assignment reassessment should be conducted at least annually although ideally after each containment response. For instance, a containment response may reveal that a targeted carbapenemase is more common than originally believed and thus movement into a lower response tier is warranted (e.g., moving NDM from Tier 2 to Non-Tier 1 or 2).

Table 1. Definitions of Response Tiers

The footnotes immediately follow the table.

Tiers	Definition
Tier 1 (highest level of response)	Organisms[1] with a **confirmed** novel or non-targeted[2] carbapenemase that has never or rarely been identified in the HCF and for which a **more extensive investigation is needed to define its epidemiology** (e.g., routes of transmission).
Tier 2	1. Organisms[3] with a targeted carbapenemase which is never or rarely detected in the HCF. These "targeted" carbapenemases are KPC, NDM, VIM, IMP, and OXA-48-like. 2. Organisms with a targeted carbapenemase which is commonly detected in a HCF and have or develop pan-resistance[4]. The pan-resistance and targeted carbapenemase combination should never or rarely be detected in the HCF. For example, KPC-producing CRE may be common and would not trigger containment, but if a pan-resistant KPC-producing CRE is uncommonly found in the HCF, it should trigger Tier 2 containment.
Non-Tier 1 or 2[5]	Organisms with targeted carbapenemases and antimicrobial susceptibility patterns that are commonly identified in the HCF and for which containment should not be routinely used.

[1] Organisms for Tier 1 response are not limited to CP-CRE and may include other antimicrobial-resistant organisms which contain novel or rare resistance patterns.

[2] Non-targeted carbapenemases are carbapenemases other than KPC, NDM, VIM, IMP, and OXA-48-like. Examples of non-targeted carbapenemases include but are not limited to rare metallo-β-lactamases such as SPM, SIM, and DIM.

[3] GAIHN-AR's activities are focused on carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE), but the scope of GAIHN-AR may expand in the future depending on capacities across sites and priorities.

[4] Pan-resistant refers to organisms which are resistant to all relevant antimicrobials tested at the clinical laboratory that serves the HCF. Relevant antimicrobials for CP-CRE are those that have activity against Enterobacterales and are available for treatment in the HCF.

[5] While not considered "containable," IPC measures to prevent the spread of non-Tier 1 or Tier 2 AR threats within healthcare settings is still essential.

Tier 1: Tier 1 responses consist of the most aggressive containment activities deployed when a **confirmed novel or non-targeted carbapenemase** has been detected and for which the epidemiological understanding of it is unclear (e.g., populations at risk, modes of transmission, etc.). **Tier 1 should not routinely be used for any targeted carbapenemase (i.e., KPC, NDM, OXA-48-like, VIM, IMP) even if they have never or rarely been identified in the HCF.** All facilities in the GAIHN-AR network should be prepared to conduct a Tier 1 response although most will never conduct one due to the rarity of this event.

On rare occasions, a Tier 1 response for suspect novel or non-targeted carbapenemases may be initiated prior to WGS result (see suspect novel or non-targeted carbapenemase section).

Tier 2: Tier 2 responses are reserved for the targeted carbapenemases for which the epidemiology (such as modes of transmission) is well understood but are rarely identified in the HCF. For example, a facility that has

never or only rarely identified CP-CRE harboring VIM carbapenemases should enact a Tier 2 containment response following identification of a VIM CP-CRE from a single index patient. For HCFs routinely identifying single organisms with multiple targeted carbapenemases, a Tier 2 response should be triggered if at least one of the carbapenemases is never or only rarely identified in the HCF.
Additionally, a Tier 2 response may be warranted for a subset of pan-resistant organisms with a targeted carbapenemase that otherwise would not meet the definition of Tier 2. For example, KPC CP-CRE may be commonly detected in a facility and would be classified as non-Tier 1 or 2. However, a pan-resistant KPC could be considered a Tier 2 response due to its increased level of resistance assuming that pan-resistant KPC is not commonly identified in the HCF.

Assignment of carbapenemases into Tier 2 should aim to minimize the number of containment responses within a HCF to only a few times a year.

Non-Tier 1 or 2: Organisms with targeted carbapenemases and antimicrobial susceptibility patterns that are more commonly identified in a HCF and **for which containment should not be used**. However, these organisms should be targeted for proactive, prevention-based activities to limit their spread in the healthcare setting, see "Global Action in Healthcare Network—Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Prevention Activities: Infection Prevention and Control".

Suspect novel or non-targeted carbapenemases (suspect Tier 1)

A suspect novel or non-targeted carbapenemase (suspect Tier 1) is sometimes identified when a CRE isolate tests positive for phenotypic carbapenemase production (e.g., mCIM positive), but subsequent molecular/enzyme testing is negative for all targeted carbapenemases. These isolates require additional testing to determine the resistance mechanism responsible for the carbapenem resistance profile. In this situation, IPC teams and laboratories should work in collaboration to determine next steps.

For an isolate with a suspect novel or non-targeted carbapenemase, the following laboratory actions should be taken:

- The isolate should be immediately sent to another laboratory, ideally a GAIHN-AR network reference laboratory
  - Testing of the isolate should be prioritized by the receiving laboratory with as short of a turnaround time as possible.
- This reference laboratory should:
  - Confirm the results of both phenotypic and molecular/enzymatic carbapenemase testing
  - If available, conduct testing for less common but well-characterized carbapenemases (e.g., SME, IMI, NMC) that would not require a Tier 1 response
- Once the reference laboratory confirms the isolate meets the definition of suspect novel or non-targeted carbapenemase, the isolate should be prioritized for WGS and the HCF IPC Teams should be alerted.

Upon receiving an alert for a suspect novel or non-targeted carbapenemase (suspect Tier 1), the HCF IPC Team should consider the following actions:

- The IPC team should immediately initiate all recommended actions described below in Section 1. Laboratory identifies any CP-CRE
- IPC team should communicate with laboratory teams to understand the status of isolate testing and anticipated turnaround times for WGS results.

- If the laboratory and IPC teams determine there is **high concern for a novel or non-targeted carbapenemase** based upon the current laboratory work-up and discussions with GAIHN-AR collaborating partners, then a Tier 1 containment response **should be** initiated even prior to sequencing results.
  - If a Tier 1 response is not pursued, HCFs should consider gathering information on current and previous index patient contacts (including potential healthcare worker (HCW) contacts).
    - A GAIHN-AR Line List for Containment Responses tool is available to help maintain a list of contacts and additional epidemiological information. Please refer to the GAIHN-AR External SharePoint site.
  - This information could be used to guide contact screening if the isolate is ultimately confirmed as Tier 1 or if there is concern for a transmission event even prior to sequencing results (i.e., multiple clinical cultures suggesting a suspect novel or non-targeted carbapenemase).
  - Because there could be a long delay between the initial alert and WGS results, screening of discharged contacts may be needed (e.g., in the community, at another facility). Thus, collecting additional information to include discharge location should be considered.

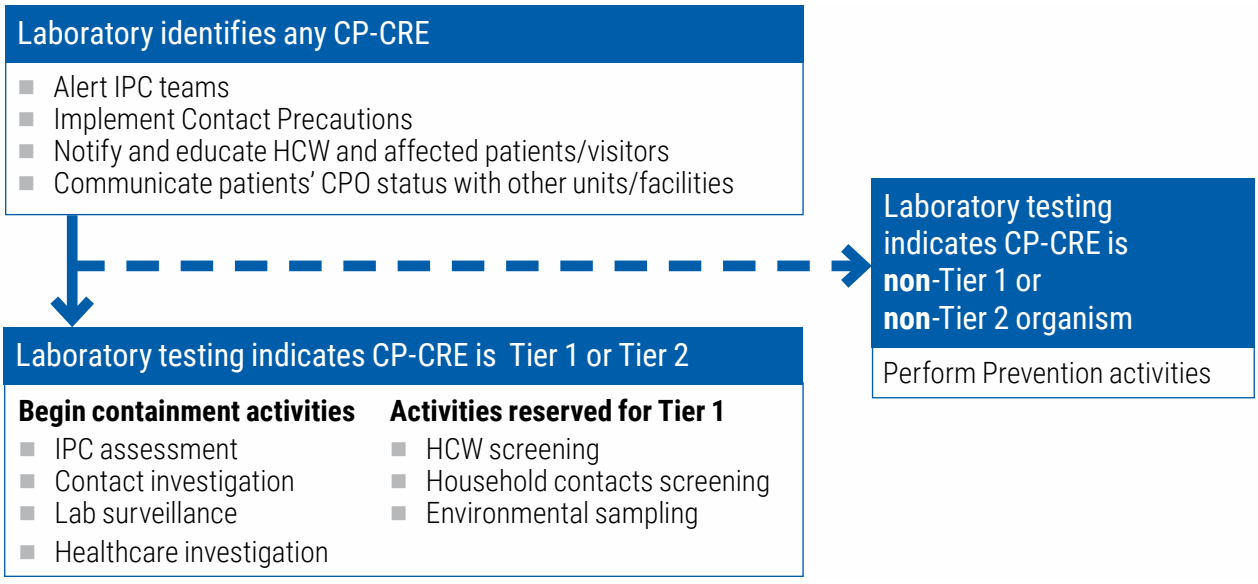
Special considerations for healthcare facilities with limited IPC and/or laboratory capacity

A containment response requires both IPC and laboratory capacity for contact screening. Thus, HCFs with limited IPC and/or laboratory capacity should first work on improving clinical culture detection of CP-CRE and improving basic IPC practices based on WHO IPC minimum requirements before initiating Tier 2 responses. However, given the seriousness of the detection of a **novel or non-targeted carbapenemase**, Tier 1 responses should still be conducted by utilizing support from other GAIHN-AR laboratories and IPC teams as needed.

Description of activities based upon laboratory testing results

Activities are divided into actions that should be taken after the identification of any CP-CRE (including those awaiting further molecular/enzyme testing), actions taken only for Tier 1 or Tier 2 CP-CRE, and actions primarily taken only for Tier 1 CP-CRE. These activities are summarized in **Figure 1** with further details on these activities provided in **Sections I and II** below.

Figure 1. Suggested actions based upon laboratory testing results



Section I. Laboratory identifies any CP-CRE

The below activities should be applied whenever the laboratory identifies any CP-CRE whether based upon just phenotypic production testing (and potentially awaiting further testing) or if molecular/enzymatic identification has been completed. This also includes any suspect novel or non-targeted carbapenemase that is awaiting further testing or other non-Enterobacterales carbapenemase producer such as *Pseudomonas aeruginosa* that are identified as part of contact screening.

Alert HCF IPC Teams

Participating network HCF laboratories should immediately alert HCF IPC teams to respond to identified CP-CRE.

Implement Contact Precautions

- Ensure Contact Precautions are in place if the patient is still hospitalized. A full description and implementation considerations for Contact Precautions can be found in the document, "Global Action in Healthcare Network - Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Prevention Activities."
- Depending upon resources, some facilities may choose to implement Contact Precaution for non-CP-CRE as well. If this is the case, laboratories should also alert IPC teams whenever a CRE is identified.
- See Appendix C for considerations regarding the discontinuation of Contact Precautions and Appendix D for links to IPC implementation considerations.

Notify and educate healthcare workers and affected patients/visitors

- The IPC team should promptly notify the patient and/or patient's family and HCWs on affected units
- HCWs on affected units, including those who are responsible for environmental cleaning and disinfection, should be educated about CP-CRE to include how it transmits and the necessary IPC measures to limit its spread.
- The patient and their visitors should be educated about CP-CRE and HCF's expectation for IPC measures during visitation.

Communicate a patient's CP-CRE status when transferring between units of the same healthcare facility and between healthcare facilities

- The decision to transfer the patient from one level of care to another should be based on clinical criteria and not on the presence of CP-CRE infection or colonization.
- If the patient with known CP-CRE infection or colonization is transferred to another HCF or between units of the same HCF, communicate with the accepting facility/unit about the patient's CP-CRE status and the necessary IPC measures prior to transfer.
    - Depending upon the receiving facility's baseline knowledge of CP-CRE and current IPC capacity and resources, public health assistance may be needed to ensure appropriate education and IPC action is implemented after transfer.

Section II. Laboratory testing indicates CP-CRE is Tier 1 or 2

Begin containment activities

The below activities are reserved only for CP-CRE identified as a Tier 1 or Tier 2 organism and for which containment activities will be conducted. On rare occasions they may also be deployed for suspect novel or non-targeted carbapenemases prior to laboratory confirmation.

- **Special Consideration:** If a patient is admitted with a known Tier 1 or 2 organism and immediately placed on Contact Precautions and the facility or other relevant partners believe adherence to this and other Standard Precautions are high, then they may choose to not initiate a full containment response. However, they should conduct prospective surveillance to detect additional patients who are infected or colonized with organisms with the Tier 1 or 2 carbapenemase.

Conduct IPC practice assessments in affected units

- An IPC practice assessment provides an in-depth understanding of a unit's current IPC practices, with an effort to assess the use and implementation of multimodal strategies. It is not just a review of a facility's policies and procedures but rather focuses on how those policies are implemented through direct observations and HCW interviews.
- For Tier 1 and Tier 2, conduct an external IPC practice assessment of the affected units if not conducted in the last 3 months or 6 months, respectively.
  - If an external assessment cannot be conducted in a timely manner, then an internal assessment should be conducted. Internal assessment findings could be validated by an external assessor later.
- If an IPC assessment was conducted in these time frames, a more focused assessment on previously identified gaps can be conducted.
- Following an assessment, partners should work to provide recommendations for IPC improvements and develop an IPC action plan to guide implementation of these suggested improvements.
- The GAIHN-AR network has created several IPC practice assessment tools, IPC action plan templates, and a guide for multimodal IPC strategy implementation considerations to aid in this process. Please refer to the GAIHN-AR External SharePoint site.

Conduct prospective and retrospective surveillance to identify additional clinical cases

- Prospective surveillance by way of monitoring of laboratory clinical cultures (i.e., blood cultures, urine cultures) for CP-CRE should continue as per facility protocol. If not currently conducting facility-wide clinical culture surveillance, the facility may want to expand this activity to all affected units identified during the containment response for at least three months from the identification of the last case.
- If feasible, retrospective surveillance (laboratory lookback) should be performed to identify isolates of the same organism with similar resistance patterns (based upon antimicrobial susceptibility testing) or the same carbapenemase enzyme/gene (if available) as far back as three months prior to the identification of the index patient.
- Results of these surveillance actions could further guide the contact investigation as described below.

Conduct a contact investigation of epidemiologically linked patients

In this guidance, a contact[6] is a patient who **currently or previously** was housed on the same unit in the HCF as the index patient. A unit refers to an area that houses a group of patients that have similar care needs (e.g., medical, surgical, intensive care) but can be arranged in different configurations ranging from patients in a single-patient room, multiple patients in multiple rooms, to one large room housing all patients.

Following the identification of a Tier 1 or 2 CP-CRE, a contact investigation with the use of colonization screening should be initiated. Colonization screening of contacts identifies unrecognized, asymptomatic carriers allowing for rapid implementation of IPC measures to limit the spread of the organism. Although resource intensive, it is an important component of **every** containment response. A GAIHN-AR Line List for Containment Responses tool stored on the GAIHN-AR External SharePoint site is available to help maintain a list of contacts, their locations, and contact screening results. Appendix A provides multiple consideration on developing a contact screening strategy particularly when screening resources are limited.

Prior to contact screening, IPC Teams should coordinate closely with the clinical laboratory to understand:

- Guidance around proper specimen collection and labeling.
- Guidance for appropriate transport conditions and times for shipping, if the contact screening swabs will be tested at a GAIHN-AR reference laboratory.

If additional targeted CP-CRE are identified through contact screening or through clinical cultures, a new alert should be triggered, and additional containment activities may be recommended based upon the HCF's response tiers (Table 1).

- **Special consideration:** Depending upon laboratory methods used for detection, CPOs beyond the prioritized CP-CRE may be detected during contact screening, such as carbapenemase-producing carbapenem-resistant *Pseudomonas aeruginosa* or carbapenemase-producing carbapenem-resistant *Acinetobacter baumannii*. These are not currently targeted GAIHN-AR organisms for the initiation of a new containment response; however, the use of Contact Precautions, notification, education, and communication should be considered following the detection of all CPOs as outlined above in Section I. Additionally, if the index patient's same gene/enzyme is detected in these other organisms as part of colonization screening, this could be indicative of a horizontal transmission event.
- HCFs may choose to implement containment actions for non-targeted CPOs. However, considerations should be made regarding resources and current priorities prior to this implementation.

Determine if there is evidence of transmission

Transmission of a Tier 1 or 2 CP-CRE is suggested by the identification of multiple patients with epidemiological linkages (e.g., common exposure to a unit in an HCF) AND the same carbapenemase isolated from clinical cultures (i.e., cultures obtained as part of routine care) and/or the identification of individuals colonized with the same carbapenemase through contact screening.

Actions upon suspected transmission **when resources allow for additional screening**:

- Determine where and for whom additional contact screening is required
  - This may include current and previous contacts who were deprioritized initially **AND** now includes contacts of the newly identified clinical or colonized patients.
- Once transmission is suspected on a unit the following actions should be taken:

[6] If a contact is previously known to be colonized or infected with an organism producing another carbapenemase (i.e., one that did not trigger the containment response), in general, they should be rescreened as part of the response to identify the acquisition of additional carbapenemases.

- Intensified IPC efforts on this unit with increased education and assessment/auditing of IPC practices.
  - This could include the establishment of dedicated areas (cohort units) with dedicated HCWs and equipment to care for those with the same carbapenemase if resources allow.
- Point prevalence surveys (PPSs) (see Appendix B) with contact screening of all patients (except those who are already known to be infected or colonized with the Tier 1 or 2 carbapenemase) on the unit should be conducted to determine if transmission is ongoing. In general, this should usually include two PPSs about two weeks apart if accompanying IPC improvements are made. If after the second PPS ongoing transmission is likely (e.g., identifying newly colonized patients), further PPS could be used intermittently to monitor transmission rates if IPC improvements are also being made.

If **resources do not allow** for additional contact screening:

- Intensified IPC efforts should be applied to any unit with suspected transmission with increased education and assessment/auditing of IPC practices.
- The use of empiric Contact Precautions could be considered for select current or previous contacts who were not screened due to limited laboratory resources. This may be particularly important for unscreened contacts who may be more likely to transmit the CP-CRE such as those on antibiotics, those who are bed bound requiring high levels of care, or those with uncontainable secretions or excretions (e.g., incontinent of stool, draining wounds, etc.)
- If not already performing, increased efforts at identifying CP-CRE from clinical cultures should be made. For example:
  - Initiate clinical culture use for units with suspected transmission among patients with signs of infection if not already implemented.
  - Enhance clinical culture utilization for diagnostic purposes in units with suspected transmission such as identifying CP-CRE from sterile or non-sterile sites among patients with signs of infection and before the initiation of empiric antimicrobial therapy.

Conduct a healthcare investigation with appropriate notification

- Review the index patient's healthcare exposures in the 30 days prior to CP-CRE detection, including overnight stays in other HCFs.
- Notify **public health authorities** if the index patient that triggered a Tier 1 or 2 containment response was hospitalized elsewhere in the 30 days before CP-CRE detection. At a minimum, the HCF that directly transferred the patient should conduct prospective and retrospective surveillance of clinical cultures if able, and if a Tier 1 organism, the facility may choose to conduct contact screening in coordination with country level authorities.
  - **Special consideration:** In some countries, authorities may also want to be notified of non-Tier 1 or 2 CP-CRE identification to determine if any additional response activities should be taken at any of these prior HCFs.
- If the patient with the CP-CRE had exposure to HCFs in other countries 30 days prior to index patient's culture, notify national, regional, or global GAIHN-AR partners.

Activities primarily reserved for Tier 1 responses

In general, the following activities are reserved for use only upon identification of confirmed, novel or non-targeted Tier 1 CP-CRE to better define their epidemiology. In very rare instances, some of these activities could be used beyond Tier 1 CP-CRE if an epidemiological investigation suggests that one of these sources is serving as a continued reservoir of transmission within the facility.

Conduct HCW contact screening

- For Tier 1 CP-CRE when:
  - The risk of HCW colonization following contact with a colonized or infected patient is unknown AND/OR
  - If the epidemiology suggests that the organism or carbapenemase may have spread to patients from colonized or infected HCW.
- Contact screening can initially be limited to HCW who had extensive contact with the index patient.
  - HCW with extensive contact generally includes those who have engaged in high contact activities such as bathing, toileting, transferring, wound care, etc.
- Prior to performing screening of HCWs, decisions should be made on how colonized or infected HCWs will be managed (e.g., work restrictions, paid leave, and rescreening).
  - Facilities should determine this policy in advance.

Conduct household contacts contact screening

- Consider screening Tier 1 household contacts, particularly those who have frequent inpatient healthcare exposures.
- In the absence of epidemiologic data suggesting household transmission, household contacts generally should not be screened for Tier 2 carbapenemases.

Conduct environmental sampling

- For Tier 1 CP-CRE, environmental sampling is indicated when:
  - There is epidemiologic evidence implicating an environmental reservoir in transmission AND/OR
  - There is a need to determine the potential role of the environment in transmission or the effectiveness of cleaning and disinfection for the organism (but not for understanding the effectiveness of environmental cleaning staff cleaning practices).
- Prior to conducting environmental sampling:
  - Facilities should discuss the availability of environmental sampling testing capacity with their clinical and reference laboratory prior to collecting samples
  - Testing laboratories must be experienced with environmental testing and will need to provide guidance to HCFs regarding sample collection, packing, transport, etc.
  - Facilities should consult with experts to interpret environmental sampling results. Use caution interpreting negative results which may not be indicative of the absence of environmental contamination.
- In general, environmental sampling is not indicated for a Tier 2 CP-CRE unless transmission is identified or suspected AND there is epidemiologic evidence implicating an environmental reservoir in ongoing transmission.

Special considerations for containment within a targeted prevention unit

Containment within a targeted prevention unit (TPU) can be triggered either through the identification of a patient with a CP-CRE via clinical culture or through routine colonization screening such as admission (i.e., colonization screening that occurs upon admission to the unit) and routine surveillance screening (i.e., colonization screening that occurs at some pre-set frequency within the unit). This section discusses suggested actions after identifying a containable CP-CRE on a TPU from clinical culture. For suggested actions based on admission and surveillance screening, see the document "The Global Action in Healthcare Network—Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Prevention Activities: Colonization Screening."

If a clinical culture identifies a Tier 1 or Tier 2 CP-CRE in a patient within a TPU the above guidance still applies with some additional considerations:

- If the TPU is performing routine surveillance screening, this activity should continue with a frequency of at least every two weeks (i.e., biweekly). However, if the laboratory is not performing carbapenemase identification on CP-CRE isolates during routine surveillance screening, this should be initiated at least for two rounds of at least biweekly screening to ensure transmission is not occurring.
  - The IPC team should communicate with the laboratory when a containment response will be initiated on the TPU if changes to standard screening protocols are required.
- If the TPU is not performing routine surveillance screening, then contact screening, ideally of all patients in the unit, should occur as detailed under contact investigation above.
- If there is evidence of transmission,
  - Intensified IPC work such as repeat infection control assessments, increased monitoring of HCW IPC practices, and repeat IPC-related training should occur.
  - If resources allow, carbapenemase identification as part of the routine surveillance screening process should continue until transmission appears to be declining or halted.
- In most TPUs, more intensive IPC-based assessments and interventions should already be occurring. Thus, if transmission is not identified, changes to currently planned quality improvement activities may not be required.

Appendix A. Consideration for prioritization of contact screening

This appendix's sub-sections, A and B, provide suggestions on contact screening strategies for current and previous contacts, respectfully; however, this protocol cannot account for the variety of complexities individual HCFs may experience during implementation. Thus, it will be important **for each HCF to document their own screening strategies in a policy/protocol** and understand the strengths and weaknesses of their plan in detecting colonized patients.

At the time of the alert, conduct screening of current contacts (i.e., patients who currently share the same unit with the index patient):

- **Tier 1:** Screen ALL contacts on the unit
- **Tier 2:** Contact screening strategies are based upon unit level factors such as rooming and bathroom configuration and contact level factors such as duration of overlap with the index patient and personal risk of CP-CRE acquisition. This protocol provides some prioritization scenarios below based on these factors; however, it does not account for all possible scenarios.
- Examples of prioritization scenarios based upon unit configurations:
  Screening strategies are listed from **most to least resource intensive**. The more resource intensive strategies will provide a more complete contact investigation and are the **recommended approach** when sufficient resources exist. However, when resources are limited, the less intensive approaches should be pursued.
  - For open units (Figure 2):
    - Screen ALL contacts who overlapped with the index patient particularly on high- risk units or TPUs (Figure 2a) **OR**
    - Screen contacts who overlapped with the index patient for at least 24 hours AND are EITHER housed near the index patient (e.g., approximately less than 1 meter in open units) OR are at high-risk of CP-CRE acquisition (even if not housed near the index) (Figure 2b) OR
    - Screen contacts who overlapped with the index patient for at least 24 hours AND are housed near the index patient (e.g., approximately less than 1 meter in open units) (Figure 2c)
  - For units with multiple rooms but only one bathroom (Figure 3):
    - Screen ALL contacts who overlapped with the index patient particularly on high-risk units or TPUs (Figure 3a) **OR**
    - Screen contacts who overlapped with the index patient for at least 24 hours AND are EITHER housed in the same room with the index patient OR are at high-risk of CP-CRE acquisition (even if not housed in the same room) (Figure 3b) **OR**
    - Screen contacts who overlapped with the index patient for at least 24 hours AND are housed in the same room with the index patient (Figure 3c)
  - For units with multiple rooms and multiple bathrooms (Figure 4):
    - Screen ALL contacts who are sharing a room or bathroom with the index patient AND those who did not share the same room/bathroom but overlapped on the unit with the index patient for at least 3 days (Figure 4a) **OR**
    - Screen contacts who shared a room or bathroom with the index patient for at least 24 hours AND those who did not share the same room/bathroom but overlapped on the unit with the index patient for at least 3 days and are at high-risk for CP-CRE acquisition (Figure 4b) OR
    - Screen contacts who shared a room or bathroom with the index patient for at least 24 hours (Figure 4c)

Conduct screening of previous contacts (i.e., patients who *previously shared the same* unit with the index patient during the 30 days prior to the CP-CRE identification).

Contacts who transferred or discharged from the index patient's current or previous unit (i.e., contacts who moved from a unit the index patient occupied) beginning 30 days prior to the CP-CRE identification:

- **Tier 1:** Screen **ALL** previous contacts beginning 30 days prior to CP-CRE identification
- **Tier 2:** HCFs may choose to screen all previous contacts. However, this could be difficult particularly if the index patient has had a long length of stay or stays on multiple units. In this case, screening at a **minimum** can be prioritized to previous contacts who in the last 30 days prior to the CP-CRE identification:
  - Either shared the same room or was housed near the index patient (e.g., approximately less than 1 meter) for at least 24 hours OR
  - Overlapped with the index patient for at least 3 days AND transferred to a high-risk unit or TPU (Figure 5)

Contacts from a previous unit the index patient occupied (i.e., contacts after the index patient moved units) for at least 24 hours beginning 30 days prior to the CP-CRE identification (Figure 6):

- **Tier 1:** Screen **ALL** previous contacts beginning 30 days prior to the CP-CRE identification
- **Tier 2:** HCFs may choose to screen all previous contacts. However, this could be difficult particularly if the index patient had stays on multiple units. In this case, at a minimum, screening on the previous units should be pursued in **BOTH** of the following situations:
  - On high-risk units or TPUs that the index patient transferred from in 30 days prior to CP-CRE identification. (Figure 6a)
    - HCFs may use the prioritization principles outlined above for the current unit if needed. (Figures 2–4)
  - On units that the index patient recently transferred from such as in the last 14 days prior to the CP-CRE identification. (Figure 6b)
    - Screening on this previous unit could be prioritized over the index patient's current unit if the transfer was very recent (e.g., last 2–3 days).
    - HCFs may use the prioritization principles outlined above for the current unit if needed. (Figures 2–4)

If these previous contacts have already been discharged, a notice should be placed in their chart and upon readmission placed on Contact Precaution and contact screening performed.

Figure 2. Tier 2 screening prioritization for contacts currently sharing a unit with the index patient on an open unit:

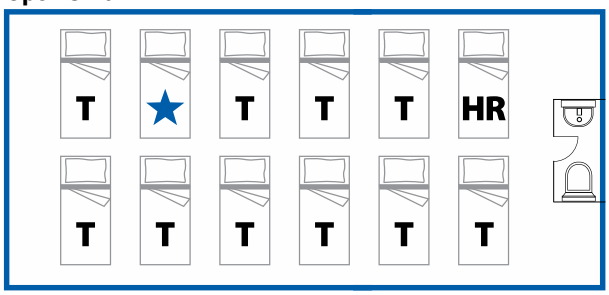
For accessible and long explanation of diagrams/models for Figure 2, 2a, 2b, and 2c go to page 28.

★ = Index patient **T** = Current contact targetted for screening **HR** = Contact at high risk for CP-CRE

NT = Not targetted for screening = Bed = Bathroom

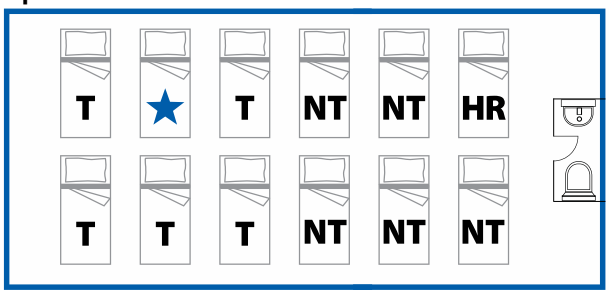
2a. If resources allow, screen the entire unit, particularly if a high-risk unit or TPU.

Open Unit



2b. If unable to screen the entire unit, prioritize those contacts who overlapped with the index patient for at least 24 hours AND EITHER are housed near the index patient OR are at high-risk for CP-CRE acquisition.

Open Unit



2c. If still unable to screen based on above recommendations, screen those contacts who overlapped with the index patient for at least 24 hours AND are housed near them.

Open Unit

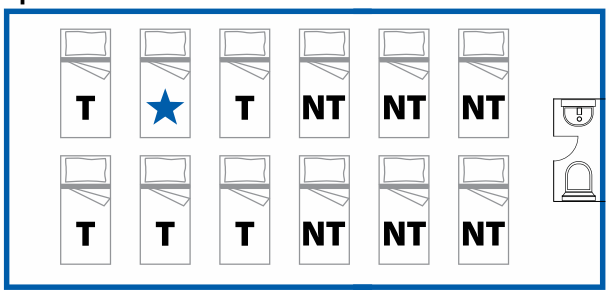


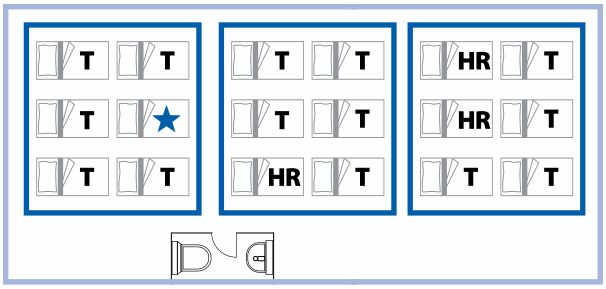
Figure 3. Tier 2 screening prioritizations for **contacts currently sharing** a unit with **multiple rooms but only one bathroom**:

For accessible and long explanation of diagrams/models for Figure 3, 3a, 3b, and 3c go to pages 28–29.

★ = Index patient **T** = Current contact targetted for screening **HR** = Contact at high risk for CP-CRE
NT = Not targetted for screening = Bed = Bathroom

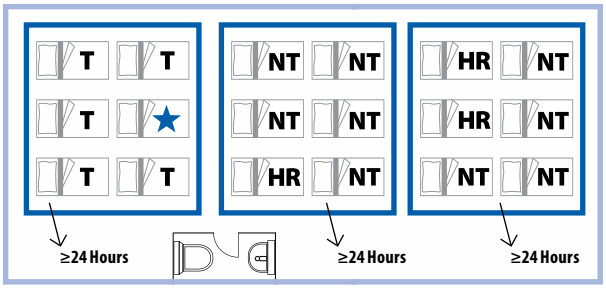
3a. If resources allow, screen the entire unit, particularly if a high-risk unit or TPU.

Multiple rooms, one bathroom



3b. If unable to screen the entire unit, prioritize those contacts who overlapped with the index for at least 24 hours AND EITHER shared a room with the index OR are at high risk for CRE acquisition.

Multiple rooms, one bathroom



3c. If still unable to screen based on above recommendations, screen those contacts who shared a room for at least 24 hours with the index patient.

Multiple rooms, one bathroom

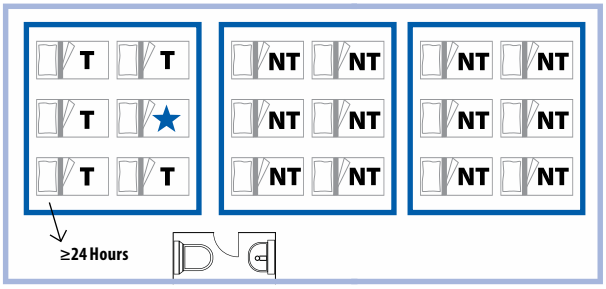


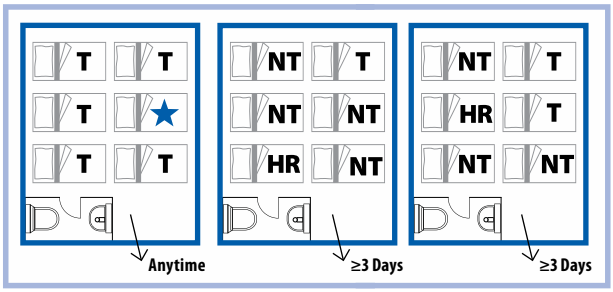
Figure 4. Tier 2 screening prioritization for contacts **currently sharing a unit** with **multiple rooms and multiple bathrooms:**

For accessible and long explanation of diagrams/models for Figure 4, 4a, 4b, and 4c go to page 29.

★ = Index patient **T** = Current contact targetted for screening **HR** = Contact at high risk for CP-CRE
NT = Not targetted for screening = Bed = Bathroom

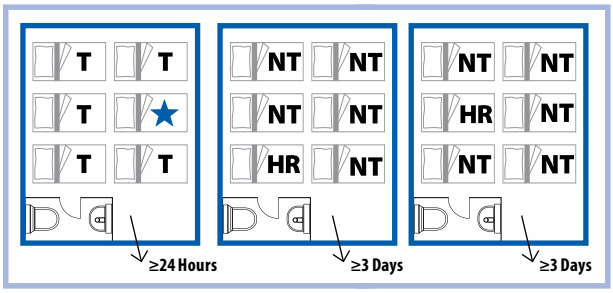
4a. Screen all contacts who shared a room and bathroom with the index patient AND contacts in other rooms who have overlapped with the index patient on the unit for at least 3 days.

Multiple rooms, multiple bathrooms



4b. If unable to screen based upon the above recommendation, screen all contacts who shared a room and bathroom for at least 24 hours AND contacts at high-risk for CRE acquisition in other rooms who overlapped with the index patient on the unit for at least 3 days.

Multiple rooms, multiple bathrooms



4c. If still unable to screen based upon above recommendations, screen all contacts who shared a room and bathroom for at least 24 hours.

Multiple rooms, multiple bathrooms

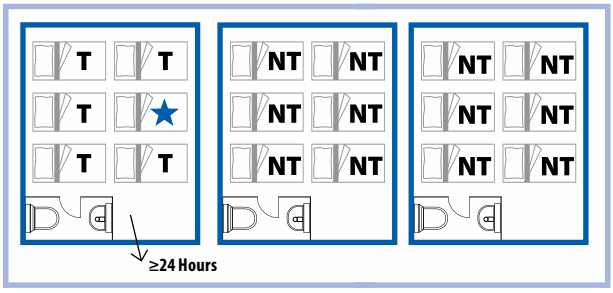
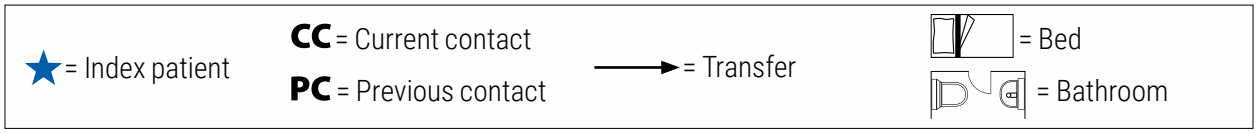


Figure 5. Previous contacts who transferred from the index patient's current or previous unit beginning in the 30 days prior to CP-CRE identification (note: this figure only depicts movement from the index patient's current unit, but the same concepts apply to patients in a unit where the index patient stayed previously):

For accessible and long explanation of diagrams/models for Figure 5 go to page 30.



Tier 2: At a minimum, screen **previous contacts** who transferred from the index patient's current or previous unit to a new unit in the 30 days prior to CP-CRE detection AND EITHER shared the same room/housed near the index patient for at least 24 hours OR overlapped for at least 3 days OR transferred to a high-risk unit or TPU

Current index patient's unit

Unit 1—Screen contacts who shared the same room/housed near the index (≥ 24 hours)

Unit 2 (high-risk unit)—Screen contacts who overlapped ≥ 3 days with the index patient AND transferred to a high-risk unit or TPU

Unit 3 (not a high-risk unit)—**May choose to not screen*** if contact not housed in the same room as the index, and Unit 3 is not a high-risk or TPU

* Screening of this contact could be considered if there is evidence of transmission in the HCF based upon the identification of colonized contacts through screening efforts and/or identification of new patients with the same targeted carbapenemase in clinical cultures.

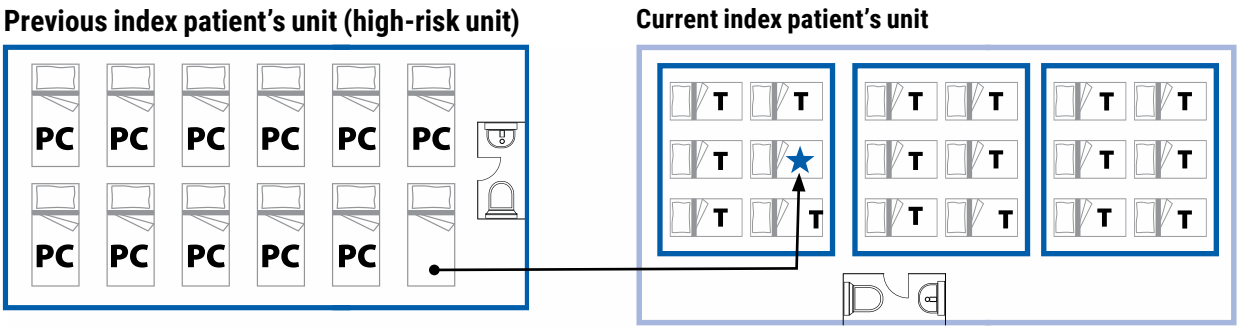
Figure 6. Previous contacts from a unit the index patient transferred from within the prior 30 days from CP-CRE identification. At minimum, screening should be pursued in BOTH of the following situations:

For accessible and long explanation of diagrams/models for Figure 6, 6a, and 6b go to page 30.

★ = Index patient
CC = Current contact
PC = Previous contact
→ = Transfer
= Bed
= Bathroom

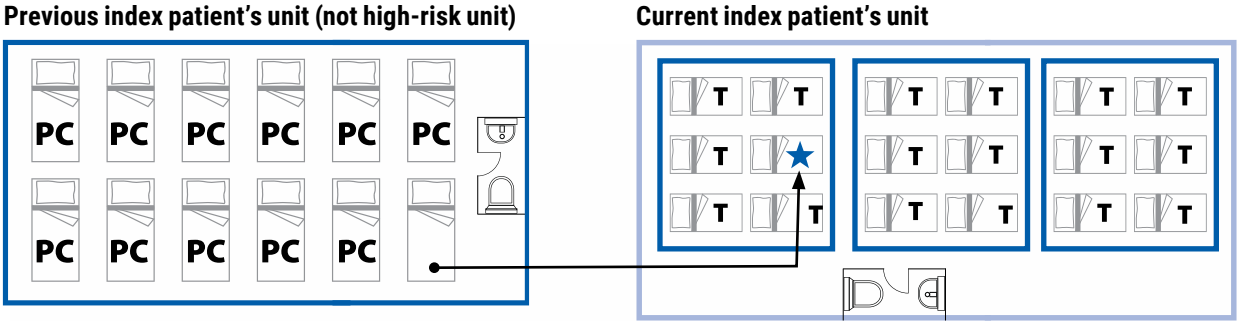
6a. Tier 2: At a minimum, screen previous contacts in **high-risk or TPUs** that the index patient transferred from in the 30 days prior to CP-CRE alert.

If resources do not allow screening of all contacts on the previous unit, then use current unit prioritization scenarios (Figs 2-4).



6b. Tier 2: At a minimum, screen contacts in previous units that the index patient spent at least 24 hours on and recently transferred from (e.g., last 14 days).

If resources do not allow screening of all contacts on the previous unit, then use current unit prioritization scenarios (Figs 2-4).



Appendix B. Point prevalence survey

A point prevalence survey (PPS) represents contact screening of all patients admitted at the time of the survey to the HCF or unit(s).

When PPS is indicated, HCF IPC team will prepare a list of all eligible patients and obtain patient's consent if applicable. PPS ideally should be completed within one day, therefore, HCF IPC team should coordinate with the surveyed unit(s) and HCF laboratory about specimen collection and processing well before the PPS day.

For the laboratory process, see "Global Action in Healthcare Network—Antimicrobial Resistance Module (GAIHN-AR) Interim Laboratory Guidance for Colonization Screening for Carbapenem-Resistant Organisms." Also, utilize the GAIHN-AR Line List for Containment Responses tool spreadsheet to track contact screening information and testing results.

Appendix C. Discontinuation of Contact Precautions

There is currently not enough information for CDC to make a general recommendation on when isolation can be discontinued for patients colonized or infected with CP-CRE given CP-CRE colonization can be prolonged (> 6 months). In general, patients previously infected or colonized with CP-CRE should be placed on Contact Precaution upon readmission to a HCF. Predictors of prolonged CP-CRE colonization include exposure to antibiotics, presence of an invasive device, severe comorbidity, and admission from or discharge to a long-term care facility. Presence of these predictor should be considered before discontinuation of Contact Precautions.

If considering discontinuing Contact Precautions based on the results of surveillance cultures, it is appropriate to wait for at least 3 to 6 months since last positive culture or colonization screening result to re-screen the patient. For individuals found to be colonized with a Tier 1 carbapenemase, HCF should consult with public health officials after 3-6 months have elapsed since last positive result to determine whether it is appropriate to re-screen.

If re-screening is conducted, the minimum criteria to conclude the patient is no longer colonized with the CP-CRE should include negative screening results from all relevant body sites (e.g., rectal swabs, wounds, original site of infection, if applicable) collected when the patient has been off antibiotics at least 7-10 days, on at least two separate occasions a minimum of 7 days apart.

Appendix D. Infection prevention and control strategies for CP-CRE

Additional IPC based resources and tools can be found in the "Global Action in Healthcare Network -Antimicrobial Resistance Module (GAIHN-AR) Interim Guidance for Prevention Activities" document. Below are some additional links related to IPC activities to aid in the prevention and control of CP-CRE in healthcare settings.

Always follow Standard Precautions

- 2007 Guidelines for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings: https://www.cdc.gov/infectioncontrol/guidelines/isolation/index.html/Isolation2007.pdf
- HICPAC. Core Practices of IPC: https://www.cdc.gov/infectioncontrol/guidelines/core-practices/index.html
- WHO Aide Memoire for Standard Precautions: https://www.who.int/publications/m/item/standard-precautions-in-health-care
- WHO Decontamination and Reprocessing of Medical Devices for Health-care Facilities: https://apps.who.int/iris/bitstream/handle/10665/250232/9789241549851-eng.pdf

Implement Contact Precautions and appropriate patient placement for patients identified with CRO

- 2007 Guidelines for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings: http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf
- PAHO Basic Recommendations on the Prevention and Control of Healthcare Associated Infections; 2017: https://www.paho.org/en/documents/basic-recommendations-prevention-and-control-healthcare-associated-infections-2017
- WHO Implementation manual to prevent and control the spread of carbapenem-resistant organisms at the national and health care facility level: https://www.who.int/publications/i/item/WHO-UHC-SDS-2019-6

Practice Hand Hygiene

- WHO Hand Hygiene Tools and Resources provides a range of tools to adopt and adapt to support local improvement in hand hygiene.

Enhance environmental cleaning in patient care areas

- Centers for Disease Control and Prevention (CDC) and Infection Control Africa Network (ICAN). 2019. Best Practices for Environmental Cleaning in Healthcare Facilities in Resource-Limited Settings: https://www.cdc.gov/hai/prevent/resource-limited/environmental-cleaning.html

Minimize device use and implement measures to prevent device-associated infections (e.g., catheter-associated urinary tract infections, central line-associated bloodstream infections)

- Guideline for Prevention of Catheter-associated Urinary Tract Infections, 2009: http://www.cdc.gov/hicpac/pdf/CAUTI/CAUTIguideline2009final.pdf
- Guideline for Prevention of Intravascular Catheter-related Infections, 2011: http://www.cdc.gov/hicpac/pdf/guidelines/bsi-guidelines-2011.pdf
- Guidelines for Preventing Healthcare-associated Pneumonia, 2003: http://www.cdc.gov/hicpac/pdf/guidelines/CDCpneumo_guidelines.pdf
- WHO and University of Washington. Training package for HAI prevention: https://depts.washington.edu/edgh/app-ipc/web/index.html

Appendix E. Summary of activities for Tier 1 organisms

Always Recommended for Tier 1

- Alert IPC of laboratory testing results
- Implement Contact Precautions
- Notify and educate HCWs and affected patients/visitors
- Clearly communicate a patient's CP-CRE status when transferring between units of the same healthcare facility and between healthcare facilities
- Conduct an IPC assessment of affected units if not conducted in the last 3 months
  - If one was conducted in the last 3 months, a more focused assessment of previously identified gaps should be conducted. Observations of current IPC practices during the care of patients colonized or infected with CP-CRE should occur during this assessment.
- Conduct prospective and retrospective surveillance of clinical isolates to identify additional cases
- Conduct contact screening of **all** current and previous contacts that are still hospitalized
- Conduct a healthcare investigation with appropriate notification of other facilities

Sometimes recommended for Tier 1

- Conduct contact screening of previous contacts who have already discharged from the affected facility
- Conduct point prevalence surveys (PPSs)

  Indicated *when*
  - There is evidence or suspicion of ongoing transmission on a unit (e.g., identifying additional patients from clinical cultures or identification of colonized individuals through initial screening efforts)

Consider in Certain Circumstances for Tier 1

- Conduct HCW contact screening
  Indicated *when*
  - A HCW had extensive contact with a case. Extensive contact generally includes high contact activities such as bathing, toileting, transferring, wound care, etc.
    AND/OR
  - A strong epidemiologic link is suspected such as the presence of known or suspected transmission from HCW.
- Conduct household contact screening
  - Consider for household contacts, particularly those who have frequent inpatient healthcare exposures
- Conduct environmental sampling
  Indicated *when*
  - There is epidemiologic evidence implicating an environmental reservoir in transmission
    AND/OR
  - There is a need to determine the potential role of the environment in transmission or the effectiveness of cleaning and disinfection for the Tier 1 organism

Appendix F. Summary of activities for Tier 2 organisms

Always Recommended for Tier 2

- Alert IPC of laboratory testing results
- Implement Contact Precautions
- Notify and educate HCWs and affected patients/visitors
- Clearly communicate a patient's CP-CRE status when transferring between units of the same HCF and between HCFs
- Conduct an IPC assessment of affected units if not conducted in the last 6 months
  - If one was conducted in the last 6 months, a more focused assessment of previously identified gaps should be conducted. Observations of current IPC practices during the care of patients colonized or infected with the CP-CRE should occur during these assessments.
- Conduct prospective and retrospective surveillance of clinical isolates to identify additional cases
- Conduct contact screening of current and previous contacts that are still hospitalized
  - If screening resources are limited, HCFs may choose to prioritize screening of certain contacts
- Conduct a healthcare investigation with appropriate notification of other facilities

Sometimes Recommended for Tier 2

- Conduct point prevalence surveys (PPSs)

  Indicated *when*
  - There is evidence or suspicion of ongoing transmission on a unit (e.g., identifying additional patients from clinical cultures or identification of colonized individuals through initial contact screening efforts)

Appendix G. Explanations of figures for accessibility

Figure 2

Figure 2a

A graphic of an open unit with 12 beds arranged in two rows with a toilet at the right end of the top row. The index patient is marked with a star in one of the beds. All other beds except the bed by the toilet are marked with "T" indicating that the contacts should be targeted for screening. The bed by the toilet is marked "HR" indicating that the contact is at high risk for CP-CRE. (Return to figure, page 19)

Figure 2b

A graphic of an open unit with 12 beds arranged in two rows with a toilet at the right end of the top row. The index patient is marked with a star in one of the beds. Five beds are directly beside or across from the index patient. These beds are marked with "T" indicating that the contacts should be targeted for screening. The bed by the toilet is not directly next to the index patient bed. It is marked "HR" indicating that the contact is at high risk for CP-CRE. All other beds are marked "NT" indicating that those patients would not be targeted for screening. (Return to figure, page 19)

Figure 2c

A graphic of an open unit with 12 beds arranged in two rows with a toilet at the right end of the top row. The index patient is marked with a star in one of the beds. Five beds are directly beside or across from the index patient. These beds are marked with "T" indicating that the contacts should be targeted for screening. All other beds are marked "NT" indicating that those patients would not be targeted for screening. (Return to figure, page 19)

Figure 3

Figure 3a

A graphic of three separate patient rooms within a unit that all share one bathroom. Each patient room has six beds, and the bathroom is outside these rooms. The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening. In the middle room, one bed is marked "HR" indicating a contact at high-risk for CRE. All other beds in the room are marked "T" indicating that the contacts should be targeted for screening. In the room on the right, two beds are marked "HR" indicating contacts at high-risk for CRE. All other beds in the room are marked "T" indicating that the contacts should be targeted for screening. (Return to figure, page 20)

Figure 3b

A graphic of three separate patient rooms within a unit that all share one bathroom. Each patient room has six beds, and the bathroom is outside these rooms. Text indicates that patients who have been in the unit for at least 24 hours should be prioritized for screening.

The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening. In the middle room, one bed is marked "HR" indicating a contact at high-risk for CRE. All other beds in the room are marked "NT" indicating that the contacts would not be targeted for screening. In the room on the right, two beds are marked "HR" indicating contacts at high-risk for CRE. All other beds in the room are marked "NT" indicating that the contacts would not be targeted for screening. (Return to figure, page 20)

Figure 3c

A graphic of three separate patient rooms within a unit that all share one bathroom. Each patient room has six beds, and the bathroom is outside these rooms. Text indicates that the patients who have been in the left room for at least 24 hours should be prioritized for screening.

The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening. All the beds in the other two room are marked "NT" indicating that the contacts would not be targeted for screening. (Return to figure, page 20)

Figure 4

Figure 4a

A graphic of three separate patient rooms within a unit, each with its own bathroom. Each patient room has six beds and a bathroom. The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening.

In each of the middle and the right room, two beds are marked "T" indicating that the contact should be targeted for screening. The other four beds in the room are marked "NT" indicating that the contacts would not be targeted for screening. Text indicates that contacts who have overlapped with the index patient on the unit for at least 3 days should be targeted for screening. (Return to figure, page 21)

Figure 4b

A graphic of three separate patient rooms within a unit, each with its own bathroom. Each patient room has six beds and a bathroom. The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening if they have been in the room with the index patient for at least 24 hours.

In each of the other rooms, one bed is marked "HR" indicating a contact at high-risk for CRE. All other beds are marked "NT" indicating that the contacts would not be targeted for screening. Text indicates that contacts at high-risk for CRE who have overlapped with the index patient on the unit for at least 3 days should be targeted for screening. (Return to figure, page 21)

Figure 4c

A graphic of three separate patient rooms within a unit, each with its own bathroom. Each patient room has six beds and a bathroom. The index patient is marked with a star in one of the beds in the room on the left. All other beds in that room are marked with "T" indicating that the contacts should be targeted for screening if they have been in the room with the index patient for at least 24 hours. All the beds in the other two room are marked "NT" indicating that the contacts would not be targeted for screening. (Return to figure, page 21)

Figure 5

A graphic of 4 units: The current index patient's unit; Unit 1; Unit 2, a high-risk unit; and Unit 3, not a high-risk unit.

The current index patient's unit contains 3 separate room with 6 beds in each room. A shared bathroom is outside the patient rooms. The index patient is marked with a star in one of the beds in the room on the left. All other occupied beds in the unit are marked with a "T" indicating that the contacts should be targeted for screening.

An arrow indicates that one patient from the index patient's room was transferred to Unit 1. This person's bed in Unit 1 is marked "PC" indicating they are a previous contact of the index patient. Text states that contacts who shared the same room or were housed near the index patient should be screened.

Another arrow indicates that a patient from the middle room of the index patient's unit was transferred to Unit 2, a high-risk unit. This person's bed in Unit 2 is marked "PC" indicating that they are a previous contact of the index patient. Text states that contacts who overlapped for at least 3 days with the index patient and transferred to a high-risk unit or TPU should be screened.

A third arrow indicates that someone from the room on the right of the index patient's unit was transferred to Unit 3, which is not a high-risk unit. This person's bed in Unit 3 is marked "PC*" indicating that they are a previous contact of the index patient. Text states that facilities may choose to not screen if the contact was not housed in the same room as the index patient, and the unit is not a high-risk or TPU. (Return to figure, page 22)

Figure 6

Figure 6a

Graphic of two healthcare facility units: an index patient's previous unit, which was a high-risk unit, and the current index patient's unit. The previous index patient's unit shows an open unit with 12 beds and a shared bathroom. The index patient's current unit has 3 rooms within the unit. Each room has six beds, and all rooms share a bathroom.

All beds in the previous index patient's unit are marked "PC" indicating that they are previous contacts of the index patient. An arrow indicates that the index patient has transferred from the previous unit to the current unit. All beds in the current index patient's unit are marked with a "T" indicating that those contacts should be targeted for screening. ((Return to figure, page 23)

Figure 6b

Graphic of two healthcare facility units: an index patient's previous unit, which was not a high-risk unit, and the current index patient's unit. The index patient's previous unit shows an open unit with 12 beds and a shared bathroom. The index patient's current unit has 3 rooms within the unit. Each room has six beds, and all rooms share a bathroom.

All beds in the index patient's previous unit are marked "PC" indicating that they are previous contacts of the index patient. An arrow indicates that the index patient has transferred from the previous unit to the current unit. All beds in the index patient's current unit are marked with a "T" indicating that those contacts should be targeted for screening. (Return to figure, page 23)

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