

# Carbapenemase-Producing *Enterobacterales*

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Infection Prevention and Control in  
Canadian Healthcare Settings



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## 1.0. Preamble

This version has new and updated recommendations for:

- Nomenclature
- Duration of contact precautions
- Screening and surveillance
- Outbreak management
- Drain management

The target audiences for this document are Infection Prevention and Control (IPC) professionals, Occupational health and safety (OHS) professionals, healthcare organizations, and healthcare providers responsible for patient care.

## 2.0. Background

Carbapenemase-producing *Enterobacterales* (CPE) are a group of antibiotic-resistant organisms (ARO), also referred to as multidrug-resistant gram-negative bacteria (MDR-GNB) capable of producing enzymes that can break down carbapenem antibiotics (e.g., *Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo- $\beta$ -lactamase (NDM), oxacillinase (OXA); Verona integron-encoded metallo- $\beta$ -lactamase (VIM)) [1]. CPE are a current type of healthcare-associated infections (HAI) that pose a concern due to their limited treatment options [1]. CPE have been associated with outbreaks in healthcare facilities worldwide and can lead to adverse clinical outcomes, and higher healthcare costs [1].

In Canada, CPE were first detected in 2008. Case numbers have been increasing since, with several large outbreaks reported [2]. PHAC has been collecting national data on CPE through the [Canadian Nosocomial Infection Surveillance Program](#) (CNISP) since 2010 [3].

The propensity of CPE to spread has serious implications for the Canadian healthcare system. CPE infections can lead to severe morbidity and mortality, especially among hospitalized patients [4][5].

The most common site for colonization with CPE is the intestinal tract, however colonization can also be found in wounds and the exit sites of devices [1][6][7]. CPE is commonly spread through indirect contact, such as through contaminated inanimate objects like shared medical equipment that has not been properly cleaned, bed rails, or colonized sink drains, but can also be transmitted by direct contact, when there is direct physical contact between the patient who is infected or colonized and the HCW and hand hygiene is not performed [8]. The incubation period from exposure to disease onset is unknown [8].

### 3.0. Aim and scope

PHAC develops evidence-based IPC guidance to guide provincial and territorial public health efforts in monitoring, preventing, and controlling healthcare-associated infections.

Recommended measures should not be regarded as rigid standards, but principles which may be used to inform IPC practice. National-level guidance should always be interpreted in conjunction with relevant provincial, territorial and local policies and regulations. PHAC guidance does not supersede provincial, territorial or local policies and regulations. PHAC will continue to consider new evidence as it becomes available. This guidance is intended for all Canadian healthcare settings.

For the purposes of this document, the term “patient” includes individuals receiving health care who are traditionally/routinely referred to as patients, clients, or residents. The term “colonization” refers the presence of microorganisms in or on a host with growth and multiplication but without tissue invasion or cellular injury.

Recommendations for non-healthcare settings are beyond the scope of this document.

### 4.0. Guideline development methodology

PHAC developed this guideline with technical expertise from the National Advisory Committee on Infection Prevention and Control (NAC-IPC).

The recommendations are informed by a review of the evidence, expert opinion and core IPC principles as identified in PHAC’s [Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings](#) (RPAP).

This guidance is based on currently available scientific evidence and expert consensus and adopts a precautionary approach where the evidence is limited or inconclusive. It is subject to review and change as new information becomes available.

### 5.0. Application of the hierarchy of controls

The hierarchy of controls is a fundamental OHS framework, designed to optimize protection of HCWs and patients from exposures to hazards, including infectious hazards such as CPE. Adhering to the recommended hierarchy of controls enhances system safety and decreases the risk of colonization, infection, or injury among healthcare workers and patients.

#### 5.1. Engineering controls

Examples of engineering controls in managing a patient with CPE include:

- Accommodation in a private single room with dedicated toilet and patient sink, as well as a designated area to don and doff personal protective equipment (PPE) safely.
- Dedicated staff hand washing sinks with soap.
- Furnishings and equipment designed to be easily and effectively cleaned and disinfected.
- Point-of-care alcohol-based hand rub (ABHR).
- Positioning of the patient, bed, and equipment to prevent contamination from sinks or showers.
- Sink design that reduces contamination from splashes.

## 5.2. Administrative controls

Administrative controls should be in place to prevent and detect any new cases of CPE in the healthcare setting.

Examples of administrative controls in managing a patient with CPE include:

- Developing and maintaining an up-to-date CPE management policy, including policies for higher-risk procedures such as duodenoscopy.
- Ensuring the facility maintains sufficient, non-expired and easily available PPE appropriate for the care of contacts of or confirmed patients with CPE and consistent with the PPE for which staff have received training.
- Screening protocols are in place for patients with CPE risk factors at facility points of entry.
- Triage procedures and prompt initiation of private room placement and appropriate PPE.
- Policies for CPE case and contact tracing.

## 5.3. Personal protective equipment

Federal, provincial, and territorial OHS Acts define specific duties for the employer, supervisor and HCW regarding PPE. The employer must ensure that the appropriate PPE is supplied in adequate amounts and sizes in all patient care areas, is readily available and in good working order, and that there has been comprehensive instruction, training, and supervision in its correct usage. Healthcare organizations need to ensure an adequate supply of appropriate PPE to protect HCWs and that their HCWs are adept in the application, use and removal of their PPE.

PHAC's recommended PPE requirements for care of patients who are confirmed cases of CPE or contacts can be found below.

## 5.4. Organizational risk assessment

Organizational risk assessment (ORA) is central to any healthcare organization's preparation and planning to protect all individuals (e.g., HCW, patient, visitor, and contractor) from CPE in all healthcare settings. Conducting an ORA will help the facility identify the effectiveness of present control measures and the breadth of the hierarchy

of controls to prevent transmission of CPE. For more information on conducting an ORA, please see PHAC's [Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings](#).

## 6.0. Routine practices for CPE management

Routine practices are those IPC measures that are used for the care of all individuals, at all times, in all healthcare settings, and are determined by the circumstances of the person being cared for, the environment, and the task being performed. Additional precautions are used when the transmission characteristics of, or impact of, infection with a specific microorganism are not fully prevented by routine practices.

Routine practices and additional precautions are covered in detail in the PHAC guidance document [Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Healthcare Settings](#).

### 6.1. Hand hygiene

An effective hand hygiene protocol is crucial in helping prevent and control the transmission of CPE in healthcare settings. Patients who are colonized or infected with CPE and their visitors should be educated on the importance of hand hygiene before eating, after using the restroom, before and after being in contact with the patient or patient care environment. For complete hand hygiene guidance, refer to PHAC's [Hand Hygiene Practices in Healthcare Settings](#).

## 7.0. Additional measures for CPE management

### 7.1. PPE

Patients who are infected or colonized with CPE should be placed on contact precautions. HCWs and visitors should don the following PPE:

- Gloves should be worn to enter the patient room, cubicle or patient's designated bedspace in shared rooms.
- A long-sleeved gown should be worn if it is anticipated that clothing or forearms will be in direct contact with the patient or with environmental surfaces or objects in the patient care environment.

Gloves and gowns should be discarded in the appropriate no-touch receptacle prior to exit.

### 7.2. Patient placement

Confirmed cases of CPE and their contacts should be flagged according to facility protocols and placed in pre-emptive contact precautions in a single room with dedicated toilet or commode [8]. Clear, visible signage should be posted on the room door for the

duration of their stay, indicating contact precaution protocols and PPE requirements.

Given the possibility of plasmid transmission of resistance genes between bacterial species, patients with CPE should only be cohorted in the same room if no private room is available, and only with other patients with the same confirmed resistant gene [7].

If placement in an open ward area is necessary on a temporary basis, ensure the patient is physically segregated from the rest of the ward area with visible isolation signage, curtains drawn (if present) and is provided with a dedicated commode until they can be transferred to a private room. PPE should be changed between patients. CPE contacts who are awaiting screening results should remain in their rooms until results are available. Confirmed CPE cases should remain in their room for the duration of their stay. Exceptions may be made for reasons of medical necessity. They should be able to perform hand hygiene independently or with assistance prior to existing and be accompanied by a HCW wearing appropriate PPE.

For other settings, such as long-term care (LTC) facilities, where restriction to a room is not reasonable, appropriate mitigation procedures should be in place to manage patients with CPE as they move around the facility, as necessary. For example, ensuring ongoing compliance with hand hygiene when moving through the facility, wearing clean clothes and avoiding touching other residents or sharing personal items, and avoiding activities that involve direct contact.

Due to the risk of contamination from splashes, all patients should be placed at a minimum distance of one (1) meter (three (3) feet), or greater, from sinks, showers and drains. If not possible in a given care space due to space restrictions, installation of a splash guard may be considered as an alternative.

### **7.3. Patient transfers between or within facilities**

Patient transfers have been associated with the spread of CPE in healthcare settings [8][9]. Therefore, transfers of patients who are infected or colonized with CPE within a facility or between facilities should be avoided unless medically indicated and for transitions of care (e.g., transfer to LTC). CPE infection or colonization should not prevent a patient from being transferred from one healthcare facility or department to another when necessary for optimal care. The receiving unit, department or facility should be notified in advance.

Appropriate PPE should be used to care for the patient during transport. The patient should perform hand hygiene with assistance, if necessary, before leaving the room.

All patient care equipment and supplies leaving the room, should be cleaned and disinfected prior to exit.

## 7.4. Environmental cleaning

All horizontal and frequently touched surfaces in the room of a patient who is colonized or infected with CPE should be cleaned a minimum of once daily and when soiled using a Health Canada-approved disinfectant with claims of efficacy against CPE and following manufacturer's instructions for use, wet contact time and surface and equipment type [10][11][12].

Healthcare facilities should have a terminal cleaning protocol in place for the room, surfaces, linens, privacy curtains and equipment of patients who are confirmed to have CPE. A terminal cleaning should occur after discharge, transfer, or discontinuation of contact precautions. All single use and disposable patient care supplies stored in the patient room should be discarded during terminal cleaning.

Environmental services workers should wear the same PPE as other HCWs when cleaning and disinfecting the patient room.

## 7.5. Drain management

Sink and shower drains can develop biofilms, which can facilitate persistent colonization of the drain with CPE [13] and have been implicated in transmission events [14].

Ongoing prevention of the environmental contamination associated with sinks, showers and drains by:

- Ensuring that sinks are constructed in accordance with jurisdictional code [15].
- Using sinks with design features that mitigate the risk of contamination, such as sinks with deep basin and faucets offset from the drain [14].
- Designating sinks for handwashing only [15].
- Educating HCWs, patients and families to avoid disposing of other substances (e.g., IV solutions, total parenteral nutrition (TPN) feeds, discarded food, etc.) and body fluids in sinks [15].
- Keeping the patient's bed, medications and all patient care items a minimum of one (1) meter (three (3) feet), or greater, away from of sinks showers and/or drains to prevent contamination [15]. If not possible in a given care space due to space restrictions, installation of a splash guard may be considered as an alternative.
- Collaborating with building facilities department to ensure there is a preventative maintenance program or policy in place for management of sinks and drains in patient care areas.

If resources and expertise are available for testing of environmental screening samples, healthcare facilities may consider conducting CPE testing on sink drains upon discharge or transfer of patients known to be colonized or infected with CPE, in particular if the facility is experiencing sustained CPE transmission [13].

Currently, data on effective regimens for contaminated sink drains are lacking. Some limited evidence suggests that products with sodium hypochlorite or accelerated hydrogen peroxide active ingredients may be effective at reducing CPE burden in drains [16][17][18].

Healthcare facilities may consider replacing the sink, sink components and/or its connected drainage system [13], though some evidence suggests that replacement alone may be inadequate as contaminated biofilm may exist more proximal to the section of drain that was removed, and re-contamination may occur [19][20][21]. Multimodal strategies may be more effective than replacement alone. [22][23][24][25].

## 7.6. Non-critical care equipment

Adequate disinfection of equipment used by a patient who is colonized or infected with CPE requires that a sufficient amount of a Health Canada-approved surface disinfectant with a DIN be applied for the appropriate contact time [12].

Single use and disposable patient care supplies should be used disposed of in a no-touch waste receptacle after use. In order to reduce waste, reusable supplies may be used if they can be effectively cleaned and disinfected between patients.

If equipment is shared with other patients, it should be cleaned and disinfected using a Health Canada-approved surface disinfectant with a DIN according to the manufacturer's instructions before reuse with another individual, and after discharge of a patient confirmed with CPE infection/colonization.

## 7.7. Endoscopes

CPE infections associated with endoscopic transmission have been well documented [15], particularly with duodenoscopes/endoscopic retrograde cholangiopancreatography (ERCP) endoscopes. Endoscopes are complex reusable medical devices with intricate channels that can harbour microorganisms if not properly cleaned and disinfected. Inadequate reprocessing or breaches in infection prevention protocols can lead to patient-to-patient transmission. Strict adherence to validated cleaning, disinfection, and IPC practices is essential to mitigate this risk.

Given the risk of endoscopic transmission, facilities may elect to determine if newly-identified patients with CPE have a prior history of endoscopy, in order to determine possible additional patient exposures resulting from inadequate reprocessing.

For more information on effective reprocessing of endoscopes, see Canadian Standards Association [CSA Z314:23 Canadian medical device reprocessing in all health care settings](#).

## 7.8. Waste, linen and nutritional services

Healthcare facilities should educate HCWs on the safe management and disposal of patient waste (e.g., stool, urine, other bodily fluids) to prevent contamination of the patient's environment and ensure HCWs safety.

Disposable items, such as bedpans and urinals, may be used. However, in order to reduce waste, reusable equipment may be used if it can be effectively cleaned and disinfected before use on other patients. If re-usable items are used, they should be dedicated to the patient for the duration of their stay. Closed systems are preferred for collecting body fluids, and drainage systems for these fluids should be disposed in adherence to local, municipal and provincial/territorial guidelines.

Routine practices are recommended for handling food or nutritional items for patients who are colonized or infected with CPE. The use of disposable meal trays or cutlery is not required.

## 7.9. Visitor considerations

Visitors of patients who are colonized or infected with CPE should be instructed to speak with a HCW before entering the patient room and should be educated on contact precautions, PPE use, and appropriate measures to prevent transmission of CPE. Visitors should be clearly instructed to wash their hands when leaving the patient's room and to avoid use of the patient's washroom.

Education should be provided to the patient at diagnosis and on discharge. The patient should be instructed to maintain good personal and hand hygiene and clean the environment frequently. Education regarding basic hygiene and its role in reducing risks posed to family members cohabitating should be reinforced. Patients should also be informed that CPE colonization is not generally considered to pose a serious risk to health family members as long as these basic measures are used and that normal social interactions may therefore continue. Communication materials for patients and visitors should address the needs of diverse populations such as those with disabilities and those who may not be fluent in either English or French.

## 7.10. Handling bodies of deceased patients

No special precautions are required for handling of deceased bodies. HCWs should follow their jurisdictional and organization-specific protocols for handling deceased bodies of patients with CPE infection/colonization.

## 7.11. Antimicrobial stewardship

Antimicrobial use (AMU) in patients with CPE infection or colonization is complex as antimicrobial choice may be limited. Therefore, ongoing antimicrobial therapy when used, should be reviewed frequently to confirm efficacy and to assess the need for

continued treatment.

## 7.12. Pediatric considerations

CPE infection and/or colonization remains an uncommon but serious problem in children and can be associated with significant morbidity and mortality, and prolonged hospitalization [26][27]. Available data suggest that the epidemiology, risk factors, and outcomes of CPE in the pediatric population mimic the trends observed in adult populations [26][27]. Neonates born to mothers who are known to be colonized or infected with MDR-GNB including CPE appear to be particularly at risk. Healthcare facilities may consider active screening of neonates based on the status of the mother.

## 7.13. CPE screening and surveillance

Key risk factors associated with CPE infection/colonization include:

- Hospitalization outside of Canada within the past 12 months [28][29].
- Previous CPE infection/colonization.
  - A large proportion of CPE carriers remain colonized even after 12 months of follow-up in a healthcare setting [5].
- Individuals directly transferred from, or with a history of admission to, a healthcare facility with a CPE outbreak within the past 12 months [4][5].
- Epidemiological linkage to a confirmed case of CPE infection/colonization [4][5].
- Patients residing in areas with a high community incidence of CPE.

Initial screening for CPE colonization on patients with one or more of the above risk factors should be performed during admission assessment or as soon as possible after admission to the healthcare facility. Individuals should be swabbed and reported promptly (as per section 9, below) to avoid delays in identifying CPE colonization. Pre-emptive contact precautions for individuals who meet the screening criteria on admission is recommended.

Screening sites for individuals at risk of CPE colonization should include:

- Rectum
- Known previously positive sites
- Clinically relevant sites (e.g. exit sites of indwelling devices)

Routine screening for CPE on admission for all admitted patients is not always cost effective or required [30][31]. However, some healthcare facilities may conduct routine screening based on population risk assessment and local epidemiology.

Because the incubation period from the time of exposure to the onset of CPE colonization is unknown, repeat screening could improve the detection rate of CPE [4][31]. When considering repeat screening, the decision should be based on several factors, including a comprehensive risk assessment (facility, unit-specific or patient-specific), and the sensitivity of the screening test being used [30]. In consultation with

experts in the field (e.g., the IPC team, an infectious disease physician, a medical microbiologist), healthcare facilities may rescreen individuals at high risk who tested negative for CPE on admission (e.g., three (3) consecutive specimens collected at least seven (7) days apart).

## 7.14. Discontinuation of contact precautions

### 7.14.1. Contacts of a confirmed case of CPE infection/colonization

Contacts are patients who have shared the same room or bathroom for an extended period of time (e.g., 24 hours) as another patient who is confirmed to be colonized or infected with CPE [32][33]. Patients should be placed on contact precautions as per section 7.1.

For contacts of a patient with CPE who have no history of CPE infection/colonization, healthcare facilities may discontinue contact precautions after a comprehensive health assessment in consultation with the IPC team, provided that:

- A minimum of three (3) consecutive negative CPE specimens collected at least seven (7) days apart have been obtained [34][35].

### 7.14.2 Patients with confirmed CPE infection/colonization

Healthcare facilities should only remove contact precautions for individuals with a history of CPE infection/colonization on a case-by-case basis after a comprehensive health assessment, in consultation with the IPC team, if:

- At least three (3) months have elapsed since the last positive sample; and
- A minimum of three (3) consecutive negative CPE specimens collected at least seven (7) days apart have been obtained, including swabs of all previously positive sites, if still present, and patient is not on antibiotics suppressive to CPE; and
- The individual remains flagged according to facility protocol and rescreened at each subsequent admission as deemed appropriate by the IPC team.

It is important to note that some patients test positive for CPE again after previously-negative screens, making it unclear whether this represents true clearance followed by recurrence or intermittent detectability [5][30][34][35].

Given the limited evidence on reliable clearance of CPE colonization, and recognizing the potential for prolonged gastrointestinal carriage and associated transmission risks, facilities should exercise caution when considering discontinuation of contact precautions for patients with a history of CPE infection or colonization

## 8.0. Laboratory considerations

## 8.1. CPE testing methods

Current laboratory methods of CPE detection include a primary screening method to detect minimum inhibitory concentrations (MIC) of carbapenems (e.g., ertapenem, meropenem or imipenem) sometimes in combination with growth on selective media. There are a number of phenotypic assays that can detect a potential carbapenemase by analyzing growth characteristics, identify a specific carbapenemase class (e.g., Class A, B) by using chromogenic assays or identify a specific carbapenemase family (e.g., NDM, KPC, OXA-48) by using immunoassays. Molecular methods such as polymerase chain reaction (PCR) is the gold standard for carbapenemase family identification but is more time consuming. It is often used after confirmation of a potential carbapenemase by any one of the phenotypic methods above.

## 8.2. CPE specimen collection and handling

Healthcare facilities should ensure that CPE specimens are collected in the appropriate medium and frequently audit the timing and frequency of the screening. Rectal specimens for CPE screening should be visibly soiled with fecal matter.

For proper laboratory biosafety procedures refer to the [Canadian Biosafety Standards and Guidelines](#).

## 9.0. Notifications

All newly identified cases of CPE should be reported by the laboratory to IPC, and to local public health authority as per applicable jurisdictional reporting requirements.

## 10.0. CPE outbreak management

Organizations should have a management plan to specifically address CPE outbreaks [36][37].

In an outbreak, a multi-disciplinary outbreak management team should be assembled to develop and coordinate interventions to halt ongoing transmission. The team should consist of, at a minimum, members from IPC, environmental services, management of the affected patient care department or area, and in reportable jurisdictions, the local public health authority. The team should meet regularly to discuss the progress of the outbreak and the need for additional outbreak measures. An epidemiological investigation of the outbreak should also take place to identify possible sources of transmission or breaches in IPC practices (e.g., contaminated equipment, inadequate disinfection of endoscopes, contaminated sinks, missed screening).

CPE outbreak response measures should be implemented in consultation with facility administration, IPC professionals, and, in reportable jurisdictions, local public health authorities.

## 10.1. CPE outbreak definition

For the purpose of this guideline, an outbreak is defined as two or more confirmed cases of CPE (not known to be colonized or infected prior or upon admission) epidemiologically linked in time and place (e.g., on the same unit within a one month period), or where incidence of CPE is higher than the expected baseline. Healthcare facilities should consult their specific provincial or territorial regulations for reporting criteria and outbreak definitions, if applicable.

## 10.2. CPE outbreak case definition

The outbreak case definition during a CPE outbreak establishes a set of criteria that define patients who are epidemiologically linked to the outbreak under investigation. Epidemiologic linkage to a case during a CPE outbreak refers to a link or association between individuals that suggests a common source or mode of transmission. This link is established through the analysis of epidemiological data, including [36][38]:

- Time: Cases occurring within a defined period are often related. Usually, a cluster of CPE cases within a specific time period raises suspicion of shared exposure.
- Place: Cases originating from the same setting/location, sharing common environmental factors, or undergoing a common procedure (e.g., endoscopy) may be epidemiologically linked. The geographical proximity of cases (e.g., room, unit, floor) is essential in identifying potential sources.
- Person: Common characteristics or exposures among affected individuals help to establish a link.
- Laboratory confirmation of the same carbapenemase resistance gene between cases may confirm an epidemiological link.

## 10.3. Point prevalence survey

In consultation with an individual with the appropriate expertise (e.g., an infectious disease physician, a medical microbiologist, and the IPC team), a point-prevalence survey should be conducted in the area affected by the outbreak to determine the extent of transmission, including individuals who have been transferred or discharged to other healthcare facilities.

Point-prevalence surveys should be repeated at least weekly until transmission has ceased, as directed by the IPC team, and in collaboration with local public health authorities.

## 10.4. Additional IPC Outbreak measures

There are several factors to consider when deciding which enhanced IPC measures to implement during a CPE outbreak, including patient health and safety considerations, the epidemiology of the microorganism, the mechanism of transmission, feasibility,

resource availability and impact [36]. It is also important to continually evaluate enhanced IPC measures and review and correct practices that may have contributed to the outbreak. The following additional IPC measures may be considered to manage and control a CPE outbreak [36][37][38]:

#### 10.4.1. HCW education and training

While staff should be educated about CPE prior to an outbreak, refresher courses on CPE transmission, and the principles of routine practices and additional precautions may be beneficial during an outbreak.

#### 10.4.2. Patient and family education

Healthcare facilities should have policies in place and regularly evaluate measures for compliance regarding additional controls (e.g., PPE) for visitors during a CPE outbreak.

#### 10.4.3. HCW auditing and compliance

In addition to regular hand hygiene audits, healthcare facilities should measure HCW hand hygiene compliance and performance and provide feedback to HCWs throughout the outbreak. Facilities should also emphasize the importance of using hand hygiene sinks exclusively for hand washing.

Healthcare facilities should consider assessing HCWs' competency in the appropriate use of PPE (selection, application, removal and disposal) and provide feedback on their performance.

#### 10.4.4. Cohorting

Healthcare facilities should consider the appropriateness of cohorting patients once the resistance mechanism has been confirmed to ensure that only patients who are colonized or infected with the same resistance gene are grouped together (e.g., KPC with KPC, VIM with VIM).

#### 10.4.5. Care environment and equipment

Outbreak cases should have dedicated patient care equipment. Healthcare facilities should consider increasing the cleaning frequency during outbreaks. If the outbreak persists and usual control measures are ineffective, facilities may consider conducting increased environmental hygiene auditing.

#### 10.4.6. Patient flow

Depending on the extent of the outbreak, healthcare facilities should consider closing a portion of a unit, an entire unit, or the entire facility. New admissions to the affected unit and intra- and interfacility transfers should be halted or, if not feasible, limited until the outbreak is resolved.

## 10.5. Contact tracing during a CPE outbreak

Healthcare facilities should conduct contact tracing of patients who have been in close contact with a patient who is confirmed to be colonized or infected with CPE during an outbreak.

Close contacts are patients who have shared the same room or bathroom for an extended period of time (e.g., 24 hours) as another patient who is confirmed to be colonized or infected with CPE [27][28].

These patient contacts should be evaluated and placed on pre-emptive contact precautions while awaiting test results.

In the absence of evidence to support screening of staff during a CPE outbreak, routine screening is *not* recommended [4].

## 10.6. Declaring an outbreak over

Before declaring an outbreak over, health care facilities should:

- Evaluate the time since the last confirmed case and conduct an adequate number of point prevalence surveys to ensure no ongoing transmission is occurring.
- Review the accuracy and reliability of laboratory testing protocols to confirm the absence of CPE cases.
- Ensure compliance with supplemental IPC measures, and relevant guidelines and regulations for declaring the end of an outbreak.

The length of time needed to declare a decrease or absence of new cases depends on various factors, including the epidemiology of CPE, and the size and complexity of the healthcare facility, in conjunction with IPC and, in reportable jurisdictions, local public health authorities. Typically, a period of several weeks to months without new cases may be considered appropriate, but this can vary depending on specific circumstances, e.g., 2-3 negative point prevalence surveys have been conducted, and 3-4 weeks have elapsed without transmission.

## 11.0. Occupational health considerations

There are no special considerations for HCWs. When caring for individuals who are colonized or infected with CPE, HCWs must adhere to all routine practices and additional precautions essential for the prevention of CPE transmission.

For more information, please consult PHAC's [Prevention and Control of Occupational Infections in Health Care](#) and individual facility's occupational health and safety program.

## 12.0. Appendix A: Acknowledgements

This guideline was developed in collaboration with the National Advisory Committee on Infection Prevention and Control (NAC-IPC). The NAC-IPC is an external advisory body that provides subject matter expertise and advice to the Public Health Agency of Canada (PHAC) on the prevention and control of infectious diseases in Canadian health care settings. More information regarding the committee and its current membership can be found [here](#).

The following individuals formed the NAC-IPC at the time this document was developed. Please note that participation in the NAC-IPC does not constitute endorsement by a member's affiliated organization(s):

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## 13.0. Appendix B: National Surveillance Programs with CPE Data

PHAC has been conducting national surveillance specific to CPE since 2010 through the [Canadian Nosocomial Infection Surveillance Program](#) (CNISP) in collaboration with the [Canadian Public Health Laboratory Network](#) (CPHLN). The resulting data is reported through the [Canadian Antimicrobial Resistance Surveillance System](#) (CARSS).

CNISP is a collaborative effort between the Public Health Agency of Canada (PHAC), including the [National Microbiology Laboratory](#) (NML), the [Association of Medical Microbiology and Infectious Disease](#) (AMMI) Canada, and acute-care hospitals across Canada that participate as members of the Canadian Hospital Epidemiology Committee, a subcommittee of the Association of Medical Microbiology and Infectious Diseases Canada (AMMI).

## 14.0. Appendix C: Abbreviations and Acronyms

ABHR	Alcohol-Based Hand Rub(s)
AMS	Antimicrobial Stewardship
ARO	Antibiotic-Resistant Organism(s)
CNISP	Canadian Nosocomial Infection Surveillance Program
CPE	Carbapenemase-Producing <i>Enterobacterales</i>
CSA	Canadian Standards Association
DIN	Drug Identification Number
HAI	Healthcare-Associated Infection(s)
HC	Health Canada
HCW	Healthcare Worker
IPC	Infection Prevention and Control
MDR-GNB	Multidrug-resistant Gram-negative bacteria (MDR-GNB)
NAC-IPC	National Advisory Committee on Infection Prevention and Control
OHS	Occupational Health and Safety
PHAC	Public Health Agency of Canada
PICO	Patient Intervention Comparison Outcome
PPE	Personal Protective Equipment

## 15.0. Appendix D: Glossary

Additional precautions	Extra measures, when routine practices alone may not interrupt transmission of an infectious agent. They are used in addition to routine practices (not in place of), and are initiated both on condition/clinical presentation (syndrome) and on specific etiology (diagnosis)
Antimicrobial resistance (AMR)	The characteristic of a microorganism that has developed resistance to the action of several antimicrobial agents and that is of special clinical or epidemiological significance. Resistance is determined by laboratory testing and assigned based on the current criteria of the Clinical Laboratory Standards Institute (CLSI).
Antimicrobial stewardship (AMS)	Conserving the effectiveness of existing antibiotic treatments through infection prevention and control guidelines, education and awareness, regulations, and oversight.
Carbapenems	A class of beta-lactam antibiotics with broad-spectrum activity recommended as first-line therapy for severe infections.
Carbapenemase-producing <i>Enterobacterales</i>	Gram-negative bacteria in the order of <i>Enterobacterales</i> that are resistant to carbapenem antibiotics by producing an enzyme (carbapenemase) to inactivate carbapenem antibiotics and several other classes of antibiotics.
Carbapenemase-producing organism (CPO)	Gram-negative bacteria that produce a carbapenemase enzyme. Includes <i>Enterobacterales</i> that produce a carbapenemase (CPE) as well as other carbapenemase-producing non- <i>Enterobacterales</i> (e.g., <i>Pseudomonas aeruginosa</i> and <i>Acinetobacter baumannii</i> ). Most CPO isolates demonstrate phenotypic resistance to carbapenems.
Colonization	The presence of microorganisms in or on a host with growth and multiplication but without tissue invasion or cellular injury
<i>Enterobacterales</i>	An order of gram-negative bacteria found in the gastrointestinal tract. According to the taxonomic change of 2020, the order has an expanded number of families in addition to the family Enterobacteriaceae. The latter includes <i>Klebsiella</i> species, <i>Escherichia coli</i> , and <i>Enterobacter</i> species, among others.
Healthcare facility	Includes but not limited to acute care hospitals, emergency departments, rehabilitation hospitals, mental health care centres and long-term care facilities.

Healthcare organization	The organizational entity that is responsible for establishing and maintaining healthcare services provided by HCWs and other staff in one or more healthcare settings throughout the healthcare continuum.
Healthcare setting	Any location where health care is provided, including emergency care, prehospital care, hospital, LTC, home care, ambulatory care and facilities and locations in the community where care is provided, (e.g., infirmaries in schools, residential or correctional facilities). (Note: Definitions of settings overlap, as some settings provide a variety of care, such as chronic care or ambulatory care provided in acute care, and complex care provided in LTC).
Healthcare worker	Individuals who provide health care or support services, such as nurses, physicians, dentists, nurse practitioners, paramedics and sometimes emergency first responders, allied health professionals, unregulated healthcare providers, clinical instructors and students, volunteers, and housekeeping staff. Healthcare workers have varying degrees of responsibility related to the health care they provide, depending on their level of education and their specific job/responsibilities.
Hospital-grade disinfectant	A substance, or mixture of substances, capable of destroying both Gram- positive and Gram-negative bacteria present on non-critical medical devices, environmental surfaces, and inanimate objects, and that is represented for use in hospitals, medical clinics, dental offices, or any other healthcare-related facility.
Infection	<p>An infection occurs when harmful organisms enter the body, increase in number, and cause a reaction of the body.</p> <p>Three things are necessary for an infection to occur:</p> <ul style="list-style-type: none"> <li>• Source: Places where infectious agents (harmful organisms such as germs) live (e.g., sinks, surfaces, human skin),</li> <li>• Susceptible Person with a way for harmful organisms to enter the body,</li> <li>• Transmission: a way harmful organisms are moved to the susceptible person</li> </ul>
Point prevalence survey	Point prevalence surveys provide baseline information about the occurrence and distribution of an HAI at a specific point in time within a healthcare setting and help to establish priorities for infection prevention and control interventions.
Surface disinfectant	Disinfectant for use on non-critical medical devices and environmental surfaces and inanimate objects in domestic, industrial/institutional, hospital, food processing establishments and/or barn premises

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