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| Victoria State Government Department of Health and Human ServicesVictorian guideline on environmental sampling for carbapenemase-producing *Enterobacteriaceae*Version 1 |

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| Department of Health |
| To receive this publication in an accessible format phone Communicable Disease Prevention and Control on 1300 651 160, using the National Relay Service 13 36 77 if required, or email Communicable Disease Prevention and Control <infectious.diseases@dhhs.vic.gov.au>Authorised and published by the Victorian Government, 1 Treasury Place, Melbourne.© State of Victoria, Department of Health and Human Services May 2018.Available on the [Carbapenemase-producing *Enterobacteriaceae* management guidelines webpage](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>. |
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Contents

[Acronyms and abbreviations 4](#_Toc504988358)

[Glossary 5](#_Toc504988359)

[Section 1: Background 7](#_Toc504988360)

[Carbapenemase-producing *Enterobacteriaceae* 7](#_Toc504988361)

[Epidemiology of Environmental CPE 7](#_Toc504988362)

[Scope of the Victorian guideline on environmental sampling for CPE 8](#_Toc504988363)

[Section 2: Governance 10](#_Toc504988364)

[Roles and responsibilities of all agencies 10](#_Toc504988365)

[Section 3: Environmental sampling methods 12](#_Toc504988366)

[Choosing sites to sample 12](#_Toc504988367)

[Recommended collection methods 12](#_Toc504988368)

[Section 4: Laboratory methods 14](#_Toc504988369)

[Laboratory methods for processing samples 14](#_Toc504988370)

[Methods for detecting CPE 14](#_Toc504988371)

[Role of the reference laboratory 15](#_Toc504988372)

[Section 5: Reporting requirements 17](#_Toc504988373)

[Requirements for primary diagnostic laboratories to report cases 17](#_Toc504988374)

[Reporting environmental screening results to the VCIMT 17](#_Toc504988375)

[Section 6: Response to identification of CPE in the environment 18](#_Toc504988376)

[Enhancement of cleaning practices 18](#_Toc504988377)

[Contaminated clinical hand basins 18](#_Toc504988378)

[Contaminated toilets 19](#_Toc504988379)

[References: 20](#_Toc504988380)

[Appendix A: Selective media 22](#_Toc504988381)

# Acronyms and abbreviations

AMR antimicrobial resistance

CDS calibrated dichotomous sensitivity test

CLSI Clinical Laboratory Standards Institute

CPE carbapenemase-producing *Enterobacteriaceae*

CRE carbapenem-resistant *Enterobacteriaceae*

EUCAST European Committee on Antimicrobial Susceptibility Testing

HI heart infusion

HSIMT health service incident management team

ICU intensive care unit

IMP imipenemase metallo-β-lactamase

KPC *Klebsiella pneumonia* carbapenemase

LTRCF long-term residential care facilities

MDU PHL Microbiological Diagnostic Unit Public Health Laboratory

MIC minimal inhibitory concentration

NDM New Delhi metallo-β-lactamase

OXA-48-like oxacillinase-48-like carbapenemases

PCR polymerase chain reaction

PPE personal protective equipment

the department Department of Health and Human Services

TRA transmission risk area

TSB tryptone soy broth

VCIMT Victorian CPE Incident Management Team

VCSRU Victorian CPE Surveillance and Response Unit

VICNISS VICNISS Healthcare Associated Infection Surveillance Coordinating Centre

VIM verona integrin-encoded metallo-β-lactamase

# Glossary

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| Carbapenemase-producing *Enterobacteriaceae* | The term carbapenemase-producing *Enterobacteriaceae* (CPE) refers to bacteria that are members of the family *Enterobacteriaceae* that have been identified to carry a carbapenemase gene. |
| Carbapenem-resistant *Enterobacteriaceae* | The term carbapenem-resistant *Enterobacteriaceae* (CRE) refers to bacteria that are members of the family *Enterobacteriaceae* that have been found to have resistance to carbapenem antibiotics by any mechanism. |
| Case | **Suspected case**A person with a species of *Enterobacteriaceae* isolated from routine clinical or screening specimens (infection or colonisation), with any of the following:meropenem minimum inhibitory concentrations (MIC) ≥ 0.5mg/L, or disc diffusion zone ≤ 24 mm using Clinical Laboratory Standards Institute (CLSI) or European Committee on Antimicrobial Susceptibility Testing (EUCAST), or calibrated dichotomous sensitivity test (CDS) disc diffusion zone ≤ 6 mm, **or**phenotypic resistance to any carbapenem where the MIC is above the clinical breakpoint as defined by CLSI or EUCAST or zone diameter suggests resistance by CDS, **or**positive colorimetric test for carbapenemase (CarbaNP or Blue-Carba).This definition of a suspected case will capture patients who are colonised or infected with bacteria that are more likely to eventually be found to be either CRE or CPE, in recognition of the need to take similar infection control action at the initial point of suspicion, prior to determining whether the bacteria is CPE.**Confirmed case**A person meeting the definition of a suspected case and where a carbapenemase gene is detected in a sample or isolate irrespective of phenotypic susceptibility, for example, KPC-2 gene-positive *Klebsiella pneumoniae*.This definition intends for the term ‘confirmed case’ to refer to a person who is colonised or infected with a CPE. |
| Frequently touched surfaces | As per national guidelines, environmental surfaces can be classified into two groups – those with minimal hand contact (for example, floors and ceilings) and those with frequent hand contact (‘frequently touched’ or ‘high-risk’ surfaces). Examples of frequently touched surfaces include doorknobs, bedrails, over-bed tables, light switches, table tops, commode chairs, and wall areas around the toilet in the patient’s room. |
| Local transmission / outbreak | Local transmission is defined as: two or more confirmed cases of genetically closely related CPE with a plausible epidemiological link, without an alternative explanation. The definition is deliberately inclusive. |
| Transmission risk area | A transmission risk area (TRA) is an area (a distinct geographical area or ward) in which local transmission has been determined by the Victorian (CPE) Incident Management Team (VCIMT) to have occurred. The time-frame for the TRA is the period when transmission may have occurred **plus** either four consecutive weeks of negative point prevalence screens **or** four weeks after the final patient involved in the transmission was discharged. The time-frame for the TRA is different from the period of transmission risk. [These concepts are explained further in Section 3 of the Victorian guideline on CPE for Health Services](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>. |

# Section 1: Background

## Carbapenemase-producing *Enterobacteriaceae*

Carbapenemase-producing *Enterobacteriaceae* (CPE) are a group of bacteria that have developed resistance to a number of front line antibiotics as well as carbapenems, which are considered ‘last resort’ antibiotics for the treatment of serious infections. In CPE, carbapenem resistance is conferred by carbapenemase genes, which encode enzymes that degrade carbapenem antibiotics. *Enterobacteriaceae* comprise the largest family of gram-negative bacteria causing human infection and includes common pathogens such as *Escherichia coli*, *Klebsiella* and *Enterobacter* species (see [Figure 1: List of *Enterobacteriaceae*](#_Figure_1:_List)). These organisms are normal flora of the gastrointestinal tract but have the potential to cause infection and disseminate antimicrobial resistance.

Release of the *Victorian guideline on carbapenemase-producing Enterobacteriaceae for health services* in December 2015 introduced a requirement for all cases of CPE identified in Victoria to be investigated for local transmission within and between healthcare facilities, by a central authority. Environmental reservoirs have been implicated in hospital CPE outbreaks internationally. Within Victoria, environmental contamination is suspected to have contributed to patient acquisition of CPE on a number of occasions, and several Victorian healthcare facilities have undertaken or considered environmental screening as a component of their outbreak investigations. However, lack of local or international standards on environmental sampling and testing methodologies for CPE has made it difficult for health services to undertake environmental screening, and to interpret the results where environmental screening has been conducted.

## Epidemiology of Environmental CPE

Contamination of the hospital environment with resistant organisms has been implicated as a source of CPE acquisition in at least five hospital outbreaks in recent years (1-5). These reservoirs have been associated mainly with bathroom and water environments and have included contaminated sinks (1-3), a wastewater drainage system (4), patient toilet (unpublished data) and a damaged patient mattress (5).

While this is overall a small number of identified CPE outbreaks, environmental investigations are rare, with reservoirs formed by unidentified colonised patients generally considered more significant than environmental sources (4, 5). In a recent systematic analysis, less than a third of the 98 examined outbreaks prompted screening of the hospital environment or instrumentation, indicating likely underestimation of environmental contamination as a source of (or contributor to) CPE outbreaks, especially in those with prolonged periods of case identification (5). In the non-outbreak setting, estimates of CPE contamination in the literature, range from 0.5% (2/371) in a cross sectional study of six acute long term care facilities in Chicago to 26% (11/43) in an acute care facility in Baltimore, sampling in the vicinity of known CPE positive patients (6, 7). Potential differences in CPE prevalence, transmission dynamics and CPE gene and species distribution across settings limit generalisability of such results. However, a recent meta-analysis reported pooled odds ratio of 2.65 (95% CI 2.02 – 3.47) when examining the association between prior room occupancy and patient acquisition of gram negative pathogens, such as *Enterobacteriaceae* (8).

In Victoria, several sites of environmental CPE contamination have been identified during outbreak investigations in health services. The sites included samples from clinical sinks, toilets, showers and dirty utility rooms. In this context, and with international recognition of the potential role of environmental contamination in CPE outbreaks, the Victorian CPE Incident Management Team (VCIMT) may recommend environmental screening is undertaken, if related CPE cases have been observed in a defined geographical area for a prolonged period of time.

This guideline has been produced based on review of available literature on environmental screening; protocols developed by three Victorian healthcare facilities that have undertaken extensive environmental screening; and additional data on the sensitivity of CPE selective media for the identification of CPE from human clinical and screening samples gathered by the Microbiological Diagnostic Unit Public Health Laboratory (MDU PHL) and from the literature.

## Scope of the Victorian guideline on environmental sampling for CPE

This guideline was developed to assist Victorian healthcare facilities considering or undertaking environmental screening as part of CPE investigations. Where a health service or long-term residential care facility (LTRCF) is directed by the VCIMT to conduct environmental screening as part of required actions for a transmission risk area (TRA) this guideline will be the reference document.

### Microbiological scope

This guideline provides recommendations around the detection and response to species of *Enterobacteriaceae* (see Figure 1 below) that contain a carbapenemase gene. Carbapenemase gene families that have been detected in *Enterobacteriaceae* in Australia thus far include IMP, VIM, and OXA-48-like, KPC and NDM.

Figure 1: List of *Enterobacteriaceae*

*Enterobacteriaceae* include the following species:

*Klebsiella spp. Serratia spp. Escherichia spp.*

*Enterobacter spp Shigella spp. Morganella spp.*

*Citrobacter spp. Salmonella spp. Proteus spp.*

*Providencia spp. Pantoea spp. Cronobacter spp.*

*Plesiomonas spp. Cedecea spp. Edwardsiella spp.*

*Raoultella spp. Ewingella spp. Hafnia alve*

*Kluyvera spp. Yersinia spp. Leclercia spp*

Suspected CPE are *Enterobacteriaceae* that have phenotypic characteristics suggestive of carbapenemase gene presence, but have not yet been confirmed. Confirmed CPE are *Enterobacteriaceae* where the presence of a carbapenemase-encoding gene has been confirmed by polymerase chain reaction (PCR) or genome sequencing.

The microbiological scope of this guideline is consistent with the 2017 Australian Commission on Safety and Quality in Health Care *Recommendations for the control of CPE: A guide for acute care health facilities* (2017). The choice of *Enterobacteriaceae* organisms reflects the greater risk that CPE carries for local transmission, including health service outbreaks and potential multi-jurisdictional spread.

The scope of this guideline does NOT extend to:

* *Pseudomonas* spp., *Acinetobacter* spp. or other non-*Enterobacteriaceae* species with carbapenemase production and resistance
* non-carbapenemase-producing *Enterobacteriaceae* that are phenotypically resistant to carbapenem (carbapenem-resistant *Enterobacteriaceae* (CRE)).producers

However, laboratories are encouraged to send carbapenemase-producing isolates that are not *Enterobacteriaceae* to MDU PHL for confirmation*.* This may help with the understanding of the extent of the challenge posed by other highly resistant bacteria.

### Management of patients with CPE

The Department of Health and Human Services (the department) has developed two separate guidelines for health services and LTRCFs that provide specific advice with respect to the infection prevention and control management of individual CPE cases and actions required when a TRA has been identified.

For health services (that is, any public or private health services, hospitals or denominational hospitals that admit patients overnight), [the *Victorian guideline on CPE for health services* V2.1 (2018) is the relevant guidance document](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>.

For LTRCFs (that is, any public or private aged care, disability service or other congruent accommodation setting in Victoria where residents are provided with personal care or health care by facility staff), [the *Victorian guideline on CPE for LTRCFs* (2018) is the relevant guidance document](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>.

# Section 2: Governance

## Roles and responsibilities of all agencies

### Department of Health and Human Services (the department)

The department is the lead agency for the Victorian response to CPE. The department has engaged several partner agencies, namely the MDU PHL and the VICNISS Healthcare Associated Infection Surveillance Coordinating Centre (VICNISS) to assist with the surveillance and response to CPE in Victoria.

The department will maintain the database for all information collected during the investigation of cases or TRAs.

The relevant roles for the department include:

* maintaining a notifiable conditions surveillance and response capability and capacity
* providing oversight of quality and safety in Victorian health services
	+ activating and maintaining the VCIMT when required.

### MDU PHL & VICNISS

MDU PHL and VICNISS are the surveillance partners of the department, collectively known as the Victorian CPE Surveillance and Response Unit (VCSRU). These organisations undertake work in assessing and responding to CPE in Victoria on behalf of the department. Both organisations are based at the Peter Doherty Institute for Infection and Immunity.

MDU PHL receives all reports and isolates of suspected and confirmed CPE, and performs further tests to confirm, characterise and sequence CPE isolates. Whole genome sequencing (WGS) and bioinformatics is used to determine relatedness of selected isolates.

VICNISS coordinates collection of data regarding patients with CPE and possible transmissions in health services, and is also available to provide advice on CPE prevention and control to health services and LTRCFs.

The VCSRU, using the information they collect, establish whether local CPE transmission is suspected to have occurred and support the VCIMT in their response to transmissions.

### Victorian CPE Incident Management Team

The VCIMT is constituted to support and oversee the public health and health service or LTRCF response to CPE. The VCIMT is activated at the discretion of the department by the identification of possible or confirmed local transmission of CPE within Victoria, and will remain activated as long as coordination of risk assessment and management is required.

The VCIMT is chaired by the Victorian Chief Health Officer or delegate, and will provide advice and guidance on required control measures based on the authority of the *Public Health and Wellbeing Act 2008.* For further information about VCIMT membership and authority [see the *Victorian guideline on CPE for health services* V2.1 (2018)](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>.

### Health services and LTRCFs

Health services and LTRCFs must implement the relevant *Victorian guideline on CPE*. If a health service or LTRCF elects to undertake environmental sampling or is directed by the VCIMT to undertake sampling the *Victorian guideline on environmental sampling for CPE* (2017) provides guidance on how this should be conducted.

#### Health Service Incident Management Team

A Health Service Incident Management Team (HSIMT) should be established when there is confirmation of local transmission of CPE, as an approach that can provide best practice governance for a response to transmission of CPE within a health service. For further information about the role of the HSIMT see the *Victorian guideline on CPE for health services V2.1* (2018) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>.

The HSIMT may elect to undertake environmental screening or be directed by the VCIMT to undertake screening.

### Diagnostic microbiology laboratories

Diagnostic laboratories identifying suspected CPE from clinical samples, are required to report suspected CPE to the department by faxing the result within one business day to 1300 651 160. All clinical, screening and environmental isolates must be sent by the diagnostic laboratory to MDU PHL for characterisation. After confirmation, the diagnostic laboratory should notify the healthcare facility infection control lead and executive as per the facility’s CPE management plan.

It is preferable that the diagnostic laboratory providing the pathology services to the health service should also process any environmental samples. Each laboratory needs to determine if they require NATA accreditation to undertake this testing and, if so, how to achieve this. MDU PHL is accredited with NATA to conduct environmental sample testing. MDU PHL may on prior consultation be able to perform the testing of environmental samples where a diagnostic laboratory does not have the capability to undertake these tests (culture and/or identification). If assistance is required, contact MDU PHL on (03) 8344 5701 before undertaking any environmental screening.

# Section 3: Environmental sampling methods

## Choosing sites to sample

Sites that may be sampled can be categorised into wet or dry surfaces. In general, *Enterobacteriaceae* species are isolated from wet or moist environments more frequently than dry surfaces, although this is also dependent on the particular organism.

Table 1 below provides a list of recommended wet and dry sampling sites from which CPE is known to have been isolated.

Table 1: Recommended environmental sample sites for CPE

| **Wet sample sites** | **Dry sample sites** |
| --- | --- |
| ToiletInside rimDrainsShowerHand basin | Frequently touched surfacesBed railsDoor handlesPatient call bell/remoteFlush button of patient toiletShared patient equipmentPatient lifting machineCommode chairPatient bath trolley |

The VCIMT may direct a health service to undertake environmental screening as part of the required responses for managing a TRA. Choice and number of sampling sites is to be determined in consultation with the VCIMT.

CPE outbreaks have also been associated with point source acquisition (for example contaminated ultrasound gel; contaminated endoscopes). Where epidemiological evidence exists for such acquisition, sampling sites should be extended to include these possibilities. Sampling should take into consideration any additional guidance documents available. For example, if microbiological sampling of endoscopes is required, it should be conducted in accordance with the current edition of the Gastroenterological Society of Australia (GESA) [Infection Control in Endoscopy](http://www.gesa.org.au/index.cfm/resources/clinical-guidelines-and-updates/endoscopy-infection-control/) <www.gesa.org.au/resources/clinical-guidelines-and-updates/endoscopy-infection-control/>. Refer to sections ‘Quality control, Microbiological surveillance cultures’ and ‘Investigation of possible infection transmission by endoscopy’.

## Recommended collection methods

Many collection devices are available for sampling environmental sites, however, Table 2 below lists those recommended for the purposes of this guideline.

Table 2: Recommended collection devices

| Collection device | Collection method | Transport media |
| --- | --- | --- |
| Flocked swab | Use swab as is if sampling a wet siteMoisten swab with sterile saline if sampling a dry site | 2-10mL enrichment broth (tryptone soy broth (TSB) or heart infusion (HI))Liquid Amies or Stuart transport media |
| Sterile gauze | Use single-use sterile forceps or other aseptic technique for handlingUse swab as is if sampling a wet siteMoisten with sterile saline if sampling a dry site | Sterile container if to be processed immediately25mL enrichment broth (TSB or HI) if specimen cannot be sent to laboratory immediately |
| Sterile sponge (with handle) | If it does not have a handle use single-use sterile forceps or other aseptic techniqueUse swab as is if sampling a wet siteMoisten with sterile saline if sampling a dry site | Sterile container if to be processed immediately25mL enrichment broth (TSB or HI) if specimen cannot be sent to laboratory immediately |

**Note:** Cotton swabs are not recommended for the collection of environmental samples.

Flocked swabs packaged with TSB or transport media are available from commercial suppliers (for example LBM™ TSB kit (Copan); ESwab™ liquid Amies (Copan)).

Pre-prepared media such as TSB or HI broth are available from commercial suppliers.

### Dry site sampling method

* If using sterile gauze or sterile sponge collection without an attached handle, a separate pair of sterile forceps must be used for each sample site.
* Moisten collection device with sterile saline immediately prior to sample collection.
* Sample a 10cm x 10cm area or the maximum area possible (for example whole of toilet flush button). Sample areas and methods must be consistent for similar sites or objects.

### Wet site sampling method

* Collection devices do not need to be pre-moistened.
* Sample areas and methods must be consistent for similar sites or objects; where possible sample a 10cm x 10cm area.
* When sampling drain sites, swab the inner surface of the drain pipe below the grate.
	+ When sampling toilets, swab the inner surface under the toilet rim.

### Transport of specimens

* Transport specimen promptly to the microbiology laboratory and process immediately.
* If specimens cannot be transported to the laboratory immediately for processing, it is preferable to place specimens into enrichment broth or liquid transport media (see [Table 2: Recommended collection devices](#_Table_2:_Recommended)).

# Section 4: Laboratory methods

## Laboratory methods for processing samples

### Samples received in transport media

* Inoculate 50µL of liquid transport media into two -10mL enrichment broth and incubate at 35-37°C for 36-48 hrs.
* Check for turbidity at 48 hrs and if turbid subculture 10 µL of broth onto selective agar.
* Re-incubate non-turbid broths for another 24 hrs. Check again for turbidity; if turbid subculture as above; if non-turbid discard.

### Samples received in enrichment broth

* Incubate enrichment broths at 35-37°C for 36-48 hrs.
* Check for turbidity at 48 hrs and if turbid subculture 10 µL of broth onto selective agar.
	+ Re-incubate non-turbid broths for another 24 hrs. Check again for turbidity; if turbid subculture as above; if non-turbid discard.

### Gauze/sponge received without transport media or enrichment broth

* Inoculate specimens directly into two -25ml enrichment broth as appropriate for the collection device (refer [Table 2: Recommended collection devices](#_Table_2:_Recommended)) and incubate at 35-37°C for 36-48 hrs.
* Check for turbidity at 48 hrs and if turbid subculture 10 µL of broth onto selective agar.
	+ Re-incubate non-turbid broths until 72 hrs incubation. Check again for turbidity; if turbid subculture as above; if non-turbid discard.

### Selective media

* Subculture onto a selective agar, preferably a chromogenic agar. A literature review of the performance of chromogenic media is tabulated in Appendix A [Table 3: Performance of chromogenic media for the identification of CPE](#_Table_3:_Performance).
	+ - Use of media with higher sensitivity is recommended. When using highly selective media more than one media may be required to cover the range of possible organisms and resistance genes.
		- Non-chromogenic agar is not recommended due to low specificity.
	+ Incubate selective agar as per manufacturer’s instructions.

## Methods for detecting CPE

* All morphotypes grown on selective agar require identification via standard methods. If the laboratory does not have the capability to identify isolates, contact MDU PHL to discuss.
* All isolates identified as *Enterobacteriaceae* should undergo at least one CPE screening test as per criteria below.

## Referral of suspected and confirmed CPE isolates to MDU PHL

* All *Enterobacteriaceae* isolates meeting **any** of the following criteria are considered suspected CPE and must be referred to MDU PHL for confirmatory testing and genomic analysis:
	+ - meropenem MIC ≥ 0.5 mg/L
		- disk diffusion zone ≤ 24 mm (CLSI or EUCAST methods)
		- CDS disc diffusion zone ≤ 6 mm
		- positive colorimetric test for carbapenemase (for example CarbaNP or Blue-Carba)
			* positive carbapenemase inactivation method (CIM) test.
* The CPE screening breakpoints have been selected to capture isolates that are carbapenemase producing, but phenotypically susceptible to carbapenems.
* Although some diagnostic laboratories have the capacity to detect a number of carbapenemase genes in *Enterobacteriaceae* by PCR testing, all suspected isolates (as defined above) must be sent to MDU PHL for further testing and sequencing (unless excluded below).
* **Please note:** if a suspected CPE is of *Enterobacter* or *Morganella* genera*,* has a meropenem MIC between 0.5 and 2 mg/L, and is CIM test negative, the isolate does not need to be sent to MDU PHL. Such isolates must be considered suspected CPE for infection control purposes until a negative CIM test result is obtained. This exclusion applies only to these two species for the MIC values listed above, and where CIM test performance has been validated by the diagnostic laboratory performing the testing.
* Isolates are to be accompanied by a completed laboratory CPE environmental isolate referral form (FM2699) which can be downloaded from:
	+ - [Department website](https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management) <https://www2.health.vic.gov.au/public-health/infectious-diseases/infection-control-guidelines/carbapenemase-producing-enterobacteriaceae-management>
		- [MDU PHL website](http://biomedicalsciences.unimelb.edu.au/departments/microbiology-Immunology/research/services/microbiological-diagnostic-unit-public-health-laboratory#services) <http://biomedicalsciences.unimelb.edu.au/departments/microbiology-Immunology/research/services/microbiological-diagnostic-unit-public-health-laboratory#services>.

## Role of the reference laboratory

All suspected and confirmed isolates must be referred to MDU PHL for further testing (unless excluded as above). This testing includes:

* extended antimicrobial susceptibility testing
* molecular and genomic characterisation to determine carbapenemase gene presence
	+ phylogenetic analysis and inference of transmission pathways, where applicable.

Flowchart 1: Sample collection and laboratory methods

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# Section 5: Reporting requirements

## Requirements for primary diagnostic laboratories to report cases

All suspected and confirmed isolates of CPE from environmental samples must be sent to MDU PHL for further confirmatory testing. There is no requirement for the primary diagnostic laboratory to report these isolates to the department; MDU PHL will advise the department of any confirmed environmental CPE isolates. Results will be reported regardless of whether these have arisen from routine environmental screening programs, investigation of sporadic cases or as part of a recognised local outbreak.

For further information regarding referral of isolates see [Referral of suspected and confirmed CPE isolates to MDU PHL](#_Referral_of_suspected).

### Other requirements for primary diagnostic laboratories

Infection prevention and control staff should be notified in a timely manner of suspected or confirmed CPE from environmental samples so that appropriate actions (for example, environmental cleaning) can be taken.

All *Enterobacteriaceae* that are suspected to be CPE are to be stored at the testing laboratory for six months.

## Reporting environmental screening results to the VCIMT

When environmental screening is undertaken in a TRA and/or at the direction of the VCIMT all results must be reported to the VCIMT. This includes a list of all of the sites sampled and all of the results, both positive and negative, for CPE.

# Section 6: Response to identification of CPE in the environment

Although the purpose of this guideline is not to provide explicit guidance for the response to CPE environmental contamination, this section outlines some potential measures that may be taken. Actions implemented will differ depending on the site of the isolate. The following suggestions may be used as a guide by the health service when developing their own action plans. The health service should consult with their engineering department for advice on engineering controls that may be used. The VCIMT may also be contacted to provide further guidance regarding possible responses to environmental CPE isolates.

## Enhancement of cleaning practices

When CPE is found in the environment, a review of cleaning practices should be one of the first measures considered. This is particularly relevant when CPE is isolated from [frequently touched surfaces](#_Frequently_Touched_Surfaces). A review of cleaning practices may include, but not be limited to:

* re-assessment of cleaning and/or disinfection products used (that is, chemicals and equipment)
* frequency of routine cleaning
* audit of the cleaning of shared patient equipment (for example, who is responsible for this, what product is available to staff to cleaning shared equipment)
* appraisal of terminal cleaning practices
	+ evaluation and/or monitoring of cleaning practices (for example fluorescent gel markers or ATP bioluminescence).

## Contaminated clinical hand basins

Contaminated clinical hand basins can present a significant transmission risk. If hand basins are found to be contaminated with CPE consider the following.

* Review how clinical hand basins are being utilised. Clinical hand basins must **only** be used to wash hands. Excess intravenous (IV) liquids, medications, left over nasogastric feeds, bed-bath water or drinks must not be disposed of into clinical hand basins, nor items or utensils (for example kidney dishes, patient clothing) washed in hand basins.
* Review the integrity of hand basins. For example, is the glazing of the hand basin still intact and easily cleanable?
* Check the water from the tap spout pours slightly offset from the drain onto the smooth surface of the hand basin. If the tap spout pours directly into the hand basin’s drain there is an increased risk of splash-back onto hands.
* Ensure there is no equipment or stock in the ‘splash-zone’ of clinical hand basins. Water dispersed while washing hands can contaminate stock (for example sterile stock or excess hand towels) or equipment stored nearby sinks.
* Consider (if sinks remain contaminated) further cleaning measures such as using a long bottle or tube brush to clean or reduce the biofilm of pipes immediately below the sink drain. Such brushes should be single-use only and disposed of after cleaning a single sink. Appropriate PPE should be worn by the cleaning staff during the process and barriers should be erected to protect patients and equipment in the immediate vicinity.
	+ More destructive methods of remediation, such as removal of pipes, should only be considered when all other measures have proven futile and the environmental burden of CPE and subsequent associated risk of transmission remains unacceptably high.

## Contaminated toilets

If toilets are found to be contaminated with CPE consider the following.

* Review toilets for any signs of damage and leaks. Damaged toilets may need to be replaced.
* If possible, ensure all toilets have lids which can be closed and provide signage to educate patients and staff to close toilet lids when flushing. Contamination of the surrounding environment may occur when toilets are flushed.
* Consider using an enhanced cleaning technique to decontaminate the toilet. Contact the VCIMT for further information.

# References:

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# Appendix A: Selective media

Table 3: Performance of chromogenic media useful for the recovery of CPE1

| Media name | Purpose of Media | Sensitivity | Specificity | Reference |
| --- | --- | --- | --- | --- |
| High sensitivity, low selectivity media |
| CHROMagar™ (ESBL; MicroMedia)2 | For detection of Extended Spectrum ß-Lactamase (ESBL)-producing bacteria, including most carrying AmpC type resistance. | 99% | 89% | Manufacturer’s specifications |
| ChromID ESBL (BioMerieux)2 | For the screening of ESBL producing Enterobacteriaceae (including *E. coli*, *Klebsiella*, *Enterobacter*, *Serratia* and *Citrobacter* (KESC) and *Proteae*) | 90-100% |  | Manufacturer’s specifications |
| 92% | 85% | (9) |
| 96% |  | (10) |
| 100% |  | (11) |
| *Brilliance*™CRE (Oxoid) | For presumptive identification of carbapenem-resistant *E. coli* and KESC. | 98% (95% CI = 93-100%) |  | Manufacturer’s specifications |
| 78% | 66% | (10) |
| 98% | 85-88% | (12) |
| 94% | 71% | (13) |
| High selectivity, low sensitivity media. |
| ChromID CARBA (BioMerieux) | Selective chromogenic medium for the screening of CPE, particularly KPC and NDM-1. | 97% | 91% | Manufacturer’s specifications |
| 92% | 97% | (11) |
| 91% |  | (10) |
| 70%3 |  | (9) |
| ChromID CARBA SMART (BioMerieux) | Bi-plate comprising CARB medium for KPC and metallo-carbapenemase-type CPE and OXA medium for OXA-48 type CPE. | 96% | 97% | Manufacturer’s specifications |

1 The choice of media requires evaluation in own laboratory based on targeted species and gene types.

2 This media is purposed for ESBL isolation and not for CPE.

3 Poor recovery of IMP-4 CRE noted.