Management and Control of Carbapenemase Producing Enterobacterales (CPE) in all Healthcare Settings

HSE AMRIC

December 2022

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Version	Date		
1.0	December 2022	This is a first version of consolidated guidance on CPE	HSE AMRIC

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Version 1.0

This version replaces all previously published HSE CPE guidance as outlined below in Table 1. Key changes are as follows:

- The guidance is divided into two sections, section 1 contains general information and management of CPE, section 2 contains details on outbreak/endemic CPE management
- The communication section has been updated to reflect open disclosure, changes to information leaflets.
- Inclusion of link to Point of care risk assessment (PCRA)
- Inclusion of link to NCEC guidance
- Inclusion of link to AMRIC HSELand modules
- Inclusion of Healthcare Workers (Acute Hospital and Community) identified as colonised with CPE or identified as CPE contacts
- Sections on palliative care, haemodialysis, Operating theatres, radiology, Hospital Out-Patient, Day Care and Primary care services
- Antimicrobial Stewardship updated to reflect updates to antimicrobial stewardship overarching guidance
- Update includes changes to the role of the hospital environment and equipment as a reservoir or as vectors for CPE including behaviours
- Risk-management: Case study for management of confirmed case of Carbapenemase Producing Enterobacterales (CPE), as per NCEC guidance
- Some editorial changes

Scope of this Guidance

This guidance is intended for healthcare workers where healthcare is provided. It replaces all previous versions of all acute and non-acute guidance for CPE. For additional guidance please go to www.hse.ie/hcai and www.hpsc.ie

Next review of this guidance document: This guidance document is due for review in 2023.

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The original guidance document (version 1.0, December 2022) on which all further updates have been developed are based on the work of the CPE expert group convened by the CPE National Public Health Emergency Team and chaired by Professor Hilary Humphreys and with support from the Antimicrobial Resistance Infection Control team and Health Protection Surveillance Centre (HPSC). Reproduction is authorised, provided source is acknowledged.

Table 1	
This document replaces all previous CPE Expert Group documents and all retired guidance and documents concerning CPE including the following:	
1.	Interventions for Control of Transmission of CPE in the Acute Hospital Sector" (2018)
2.	Acute Hospital Carbapenemase Producing Enterobacterales (CPE) Outbreak Control Checklist". (2018)
3.	Assessing Evidence of Transmission and end of Transmission of Carbapenemase Producing Enterobacterales (CPE), Version 1.0".
4.	Requirements for Screening of Patients for Carbapenemase Producing Enterobacterales (CPE) in the acute hospital sector, Version 2.0, April 2019"
5.	Control of Transmission of Carbapenemase Producing Enterobacterales (CPE) in the Acute Hospital Setting, CPE Expert Group, January 2020
6.	Discussing healthcare associated infection (HCAI) and specific antimicrobial resistant organisms (AMROs) with patients who may have acquired a HCAI, become colonised with an AMRO or been exposed to a specific HCAI/AMR risk 2018.
7.	Acute Hospital CPE Outbreak Control Checklist
8.	Guidance relating to CPE for long term care facilities June 2018
9.	Hospital outpatient and day care facilities June 2018
10.	Requirements for screening for Carbapenemase-producing Enterobacterales 2019
11.	Control of CPE in the acute hospital setting Sept 2021
12.	CPE Haemodialysis Guidance
13.	Control of CPE in the acute hospital sector guideline and checklist Version 2 Final
14.	Palliative Care CPE guidance
15.	People with AMRO or CPE for healthcare workers in the community Sept 2018
16.	Guidance Relating to Laboratory Testing for Carbapenemase Producing Enterobacterales (CPE) and the Interpretation and Clinical Application of Results 2019
17.	Provisional Guidance relating to Inter-facility Transfer of Patients Colonised or Infected with Antimicrobial Resistant Organisms (AMRO) Including Carbapenemase Producing Enterobacteriaceae (CPE), 2018.

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Glossary of Terms

Term	Definition
Antimicrobial	An antimicrobial is a medicine used to prevent and treat infections in humans, animals, and plants. Antimicrobials include antibacterials, antivirals, antifungals, and antiparasitics. In this document, antimicrobial primarily refers to antibacterial agents, although the principles of stewardship apply equally to antivirals, antifungals and antiparasitics.
Cohorting	Cohorting refers to accommodation of two or more patients in a space that they share with each other, but which is separate from space used by other patients
CPE	Carbapenemase Producing Enterobacterales The following in alphabetical order are some of the more common carbapenemase enzymes. There are a number of other carbapenemase enzymes: **IMP**: Imipenemase **KPC**: Klebsiella pneumoniae carbapenemase **NDM**: New Delhi metallo-beta-lactamase **OXA**: Oxacillinase-type carbapenemase (OXA-48 is the most common variant in Ireland) **VIM**: Verona Integron-encoded metallo-beta-lactamase
CRE	The terms carbapenemase producing *Enterobacteriales* (CPE) and carbapenem resistant *Enterobacteriales* (CRE) are often used interchangeably by healthcare workers when referring to a family of bacteria that live in the bowel. CPE/CRE have developed the ability to become resistant to last-resort powerful antimicrobials known as carbapenems, which makes them more challenging to treat if they go on to cause infection.
Service user	Any recipient of healthcare services. For the purposes of this guidance, this term includes 'service users', 'patients' 'residents', 'clients' and 'consumers'.
Isolation	Isolation refers to accommodation of one patient in a single room and the application of a series of specific Infection Prevention and Control measures to reduce the risk of transmission of specific microorganism from the person in the room.

Acronyms

AMAU	Acute Medical Assessment Unit
AMR	antimicrobial resistance
AMRO	Antimicrobial-Resistant Organisms
AMRIC	antimicrobial resistance and infection control
AMS	antimicrobial stewardship
CHOs	Community Healthcare Organisations
CPE	Carbapenemase producing Enterobacterales
CRE	Carbapenem-resistant Enterobacteriaceae
ED	Emergency Department
ESBL	Extended-spectrum beta-lactamase producing Enterobacterales
EUCAST	European Committee on Antimicrobial Susceptibility Testing
GP	general practitioner
HCAI	Healthcare associated infection
HCWs	healthcare workers
HSE	Health Service Executive
iNAP	Irish National Action Plan for Antimicrobial Resistance
IPC	infection prevention and control
IPCT	Infection Prevention and Control Team
LTCF	Long term care facility
OCT	Outbreak control team
RCF	residential care facility
MIC	Minimum Inhibitory Concentration
MRSA	methicillin-resistant *Staphylococcus aureus*
NCPERL	National Carbapenemase-Producing Reference Laboratory
PCR	polymerase chain reaction
PCRA	Point of care risk assessment
Person/People	The terms person/people are generally used in this document and are in general interchangeable with the terms client, service user or patient
RCF	Residential care facility
PPE	Personal protective equipment
UTI	Urinary tract infection
VRE	Vancomycin resistant enterococci
WHO	World Health Organization

Executive Summary

Antimicrobial resistance (AMR) has been recognised as one of the greatest potential threats to human and animal health over the last decade. In November 2021, Ireland published its second *One Health National Action Plan on Antimicrobial Resistance 2021 – 2025*, (iNAP2). This provides for a co-ordinated cross-sectoral response to antimicrobial resistance, which has impacts every day on how we prevent and treat infection in Ireland. There is an increased emphasis in iNAP2 on the environmental aspects and on infection prevention and control. Importantly, we all have a role to play in stopping antimicrobial resistant bacteria and antimicrobial resistance genes spreading from person to person, animal to animal, and also between people and animals. As part of the iNAP2 action plan, we also need to stop widespread dissemination of antimicrobial resistant bacteria through environmental pollution with human and animal faeces.

In the period 2017-2022, the HSE has and continues to work closely with the Department of Health to respond to the Carbapenemase Producing Enterobacterales (CPE) Public Health Emergency. CPE was added to the statutory list of notifiable diseases in December 2018. A key achievement of that joint working relates to reductions in number of CPE cases. When iNAP1 was launched, the number of people newly detected with CPE in Ireland was increasing rapidly year on year. There were indications that this stabilised somewhat in 2021; however, it appears that CPE detections along with detection of other multi-drug resistant organisms have begun to increase again in 2022.

In recent years, infection prevention and control multidisciplinary resources have been strengthened nationally. Acute hospitals and community IPC and AMS teams play a greater role in how services are delivered for patients and their families. There is improved awareness and understanding of the issues of AMR and IPC both among healthcare workers and the public. This document consolidates existing guidance which provides support to healthcare workers to safely manage CPE in healthcare settings; it also compliments other guidance including Antimicrobial Stewardship Guidance for All Healthcare Settings, and NCEC Draft Guidance on Infection Prevention and Control, 2022.

Dr. Eimear Brannigan, Clinical Lead, HSE AMRIC

What does this CPE guidance cover?

This guidance brings together the content of previous CPE guidance in one guidance document for staff in healthcare settings, including acute and non-acute hospital and residential care facilities.

SECTION 1

Overview of Carbapenemase Producing Enterobacterales (CPE) in Ireland

Introduction

Antimicrobial resistance is a major challenge to healthcare delivery in Ireland and throughout the world. Control of antimicrobial resistance is grounded in improved use of antimicrobial agents (antimicrobial stewardship) and better control of the spread of antimicrobial resistant organisms (IPC). Managing transmission of antimicrobial resistant bacteria particularly in the acute hospital setting is very challenging with several competing demands placed on the system. This document is intended to support all healthcare facilities in focusing on those infection prevention and control (IPC) measures likely to be most effective in controlling the spread of CPE and other antimicrobial resistant bacteria. Implementing these measures may impact on continuity of overall clinical service, in the context of the acute hospital settings.

It is important to note that, as with all IPC practice, measures to manage the risk of transmission must be adapted to take account of the needs of individual patients or residents, for example those with challenging behaviour, dementia and in those approaching end of life.

This document should be considered in association with Draft National Guidelines for Infection and Prevention Control (IPC) 2022 which is available at the following link **ncec-ipc-guideline-2022-for-consultation.pdf (hse.ie)**.

Challenges with CPE

CPE is not a homogenous group of organisms. Although sub-classification of CPEs may be confusing, the distinctions are important. The more common categories of CPE, in alphabetical order, are IMP, KPC, OXA-48, NDM and VIM as listed in the Glossary of Terms.

Two of these, NDM and VIM, are metallo-beta-lactamases. This means the carbapenemase enzyme has a metal ion at the active site. The other three enzymes, IMP, KPC and OXA-48 do not have a metal ion at the active site. Although treatment options are limited for all CPE, the treatment options are frequently even more limited for metallo-beta-lactamase-producing Enterobacterales, such as NDM and VIM.

It is important in the context of managing these patients, particularly in acute hospital settings, that cohorting patients who are colonised with different categories of CPE must be avoided to prevent spread of different categories of CPE between patients.

Epidemiology of Carbapenemase Producing Enterobacterales (CPE) in Ireland

CPE was first reported in Ireland in 2009 and was made a notifiable infection in 2011. At that time, a voluntary enhanced surveillance scheme for CPE began. In 2012 the National CPE Reference Laboratory was established. As incidence of CPE was increasing rapidly in 2016, the voluntary surveillance was ended and replaced with a mandatory CPE enhanced surveillance scheme in which all microbiological laboratories are required to report information on newly detected CPE cases (from screening and diagnostic specimens, including colonisation, non-invasive and invasive infections) to the Health Protection Surveillance Centre (HPSC). Furthermore, all acute HSE hospitals are required to report on monthly CPE performance indicators to the Business Information Unit of the HSE. The Minister for Health declared a national public health emergency on CPE in October 2017, which spurred improved CPE surveillance and reporting of CPE in acute hospitals.

In general, isolates from diagnostic samples are likely to reflect clinical infection, whereas isolates from surveillance samples reflect detection of CPE gut colonisation in the absence of clinical CPE infection. Detection of most cases of CPE in surveillance samples, as is currently the case in Ireland, reflects a system in which most people with CPE are detected relatively early in their contact with the healthcare system allowing early application of measures to control spread.

The number of newly detected CPE patients in Ireland has remained relatively stable since 2018. However, there has been a steady increase in cases over the course of 2022.

Changing epidemiology

The epidemiology of CPE in terms of pathogens and resistance mechanisms has changed over time and continues to evolve. As seen internationally, the proportion of carbapenemase type KPC has decreased over time as numerous other types (OXA-48, NDM, VIM, IMI, IMP) have increased. This has had a major impact on IPC practice, creating the need to have separate isolation according to type of CPE.

Currently the most prevalent carbapenemase type in Ireland is OXA-48, making up 68% of the newly detected cases in August 2022. This is followed by KPC at 12% (found only in one hospital group), VIM at 11% (found only in two hospital groups), and NDM at 9% (NCPERLS data). Currently the majority of newly detected CPE cases in Ireland are OXA-48. Other types detected are KPC, VIM, and NDM.

Monthly surveillance reports on Carbapenemase Producing Enterbacterales (CPE) are available in the following link:

https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/strategyforthecontrolofantimicrobialresistanceinirelandsari/carbapenemresistantenterobacteriaceaecre/surveillanceofcpeinireland/cpemonthlysurveillancereports/

Infection Prevention and Control (IPC)

Standard and Transmission-based Precautions

Successful IPC involves implementing work practices that reduce the risk of transmission of microorganisms through a two-tiered approach, including:

Routinely applying basic IPC strategies to minimise risk to both people who use healthcare services and healthcare workers, such as hand hygiene, respiratory hygiene, appropriate use of personal protective equipment, cleaning and safe handling and disposal of sharps (Standard Precautions).

Standard Precautions

Any IPC strategy should be based on the use of Standard Precautions as a minimum level of control. Standard Precautions are used by healthcare workers to prevent or reduce the likelihood of transmission of microorganisms from one person or place to another and to render and maintain objects and areas as free as possible from infectious microorganisms. Effectively managing microorganisms where Standard Precautions may not be sufficient on their own – these specific

interventions control infection by interrupting the mode of transmission (Transmission-based Precautions).

Transmission-based Precautions

Transmission-based Precautions are recommended as additional work practices in situations where Standard Precautions alone may be insufficient to prevent transmission. This includes the use of Transmission-based Precautions in the event of an outbreak to assist in containing the outbreak and preventing further transmission/infection.

Transmission-based Precautions should be tailored to the particular infectious microorganisms involved and its mode of transmission. This may involve a combination of practices. When a person is known to have infection or colonisation with CPE, staff should be particularly careful with respect to their practice of standard precautions and should take additional precautions when required. In settings where there is very limited direct physical contact with the person there is no requirement for the healthcare worker to wear personal protective equipment. Examples include brief social contact such as shaking hands. For further guidance regarding point of care risk assessment refer to

https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/posters/

Further detail is contained within Draft National Guidelines for Infection and Prevention Control (IPC) 2022 which is available at the following link ncec-ipc-guideline-2022-for-consultation.pdf (hse.ie)

A suite of AMRIC Infection prevention and control training and education resources are available on HSELand at:

https://www.hseland.ie/ekp/servlet/ekp?TX=STRUCTUREDCATALOG&CAT=EKP107280034

Guiding principles for patients/clients colonised with CPE

People colonised or infected with CPE have the same right to access health and social care as everyone else and should not experience significant delays in transfers in either direction between residential care facilities, non-acute care facilities and hospitals simply because they carry CPE.

People who use healthcare services are entitled to expect that the healthcare service will take care to protect them to the greatest extent practical from the risk of acquiring CPE while using healthcare services. In the spirit of open disclosure and communication regarding the risk to people using healthcare facilities, they should know that the risk cannot be eliminated entirely. Other

people using the facility may be colonised with antibiotic resistant organisms such as CPE. They need to ensure that all service users get the care they need in a safe manner.

CPE colonisation

What is a CPE Case/CPE colonisation?

A CPE case is a patient from whom CPE has been detected in a clinical specimen (invasive infection, non-invasive infection or colonisation).

Note that detection of CPE from any site is a notifiable disease.

Refer to https://www.hpsc.ie/notifiablediseases/notifyinginfectiousdiseases/ for details of notifiable diseases.

A person who carries CPE in the gut but who has no clinical symptoms or illness related to the CPE is said to be colonised. People may also have asymptomatic CPE colonisation of urine, leg ulcers or indwelling devices.

CPE in the gut do not cause diarrhoea, vomiting or abdominal pain. In a small number of people colonised with CPE in the gut the CPE may cause cystitis, pyelonephritis or sepsis.

Within the acute hospital setting, a patient is considered a suspected CPE case when an isolate that is likely to be CPE has been detected but laboratory confirmation is not complete. Confirmation of an isolate as CPE should generally be available within 2 to 3 hours but there may be exceptional situations with unusual types of CPE where confirmation may be delayed. If there is delay in confirmation the precautions that apply to a CPE case should apply pending a definitive laboratory report.

Retesting of the Person is Confirmed Positive for CPE?

Retesting of people confirmed positive for CPE is generally not necessary. There may some cases when it is appropriate. Some people are particularly distressed by the experience of being designated as CPE colonised. A person who has been designated as CPE colonised may have the CPE designation removed if more than 12 months have elapsed since the most recent positive CPE detection and there have been four or more CPE screening samples reported as CPE not detected during that 12-month period. At least one of those samples must have been taken more than four weeks after their most recent positive test for CPE.

Note, it is important to provide clear information to the person indicating that while the designation of CPE colonised is removed from their patient record it is not possible to give them an assurance that CPE has definitively cleared. There is reason to believe that in some people CPE may become undetectable for a period of time and yet re-emerge subsequently for example following exposure to antimicrobial agents. Therefore all people formerly designated as positive for CPE but who have had that designation of CPE positive removed should be included in the population screening process.

CPE Contact

Defining what is meant by a CPE Contact?

A CPE contact is a term used to refer to a person who has been identified by an IPC team or public health doctor as having significant exposure to a person colonised or infected with CPE and as a result of this exposure is at higher risk of being colonised with CPE. IPC teams are required to use professional judgement in the designation of exposed people as CPE Contacts. A person is generally identified as a CPE contact because they have spent hours in the same space in a healthcare setting as someone who is colonised with CPE. Identification of a person as a CPE contact generally relates to exposure to CPE in the acute hospital setting. Being a CPE contact does **NOT** mean that the person has acquired CPE.

CPE contacts in acute hospital settings

A person is considered as exposed to CPE if they have shared a multi-bed area or bay and/or are known to have shared toilet facilities with a person identified as colonised or infected with CPE. A person may also be exposed if they are accommodated in a room or are known to or are very likely to have used a toilet, shower or other facilities where CPE has been detected on touch surfaces.

In general, designation as a CPE Contact will mean that the person has been assessed as having exposure that lasted for 12 hours or more. People who are identified as exposed for periods shorter than 12 hours are generally not considered CPE Contacts.

Following a report in January 2020, “Carbapenemase Producing Enterobacterales (CPE) Patient Contact Communication Evaluation” and based on the data within this report and previous guidance (Control of Transmission of Carbapenemase Producing Enterobacterales (CPE) in the Acute Hospital Setting National Guidance Document, Version 3.0 September 2021) the designation of a person as a CPE contact was updated as below.

Given the existence of a comprehensive CPE testing programme for admissions across acute hospital settings it is no longer considered as generally appropriate to designate patients as CPE contacts if they have left hospital before person they have shared space with is identified as CPE colonised or infected. Exceptions, however, may be appropriate based on risk assessment. People who are designated as CPE contacts must be informed in a timely manner, including those who have left the hospital. The requirements for communication with patients who are deemed CPE contacts are outlined in the section in this guidance related to communication.

Identifying CPE Exposure and CPE Contacts

A person is considered as exposed to CPE if they have shared a multi-bed area or bay and/or are known to have shared toilet facilities with a person identified as colonised or infected with CPE. A person may also be exposed if they are accommodated in a room or are known to or are very likely to have used a toilet, shower or other facilities where CPE has been detected on touch surfaces. Assessment of exposure should take account of time spent in the Emergency Department (ED) and Acute Medical Assessment Units (AMAUs). It is acknowledged that identification of exposure in ED can be particularly challenging. In general, only those people who were subsequently admitted to hospital from the ED and who can be positively identified by the IPC team as having received an intensity of care comparable to an in-patient in an open area during the same time that the person colonised or infected with CPE was in the area should be considered as exposed. When assessing exposure of others in relation to a person colonised or infected with CPE it is sufficient to limit the period under consideration as from the beginning of the period of the acute hospital admission during which CPE was first detected. If the person has had samples reported as CPE not detected/CPE negative during an admission, but then tests CPE positive later in that admission, it is sufficient to limit the period under consideration as from the date of the most recent sample reported as CPE not detected/CPE negative.

In relation to CPE environmental exposure there is generally no practical way to identify at what point the touch surface in question became colonised with CPE. A pragmatic approach is to limit the identification of contacts to those in patients who are known to have been in that space or are very likely to have been in the space in the two days prior to first detection of CPE on a touch surface. It may be necessary to consider a longer period if there is epidemiological evidence that a particular environment (for example a shower tray, clinical hand wash basin adjacent to the patient location etc.) has been clearly associated with CPE transmission. Patients who are known

to have or are very likely to have used that shower or been exposed to splashing into their bed space from the clinical hand wash basin are regarded as CPE contacts.

CPE contacts in community settings

CPE contacts in community settings: in most cases in the community all that is required in relation to a CPE Contact is to be particularly conscious of standard precautions. When CPE contacts are admitted to an acute hospital they are offered testing for CPE and special precautions are taken in their care.

All relevant patient information leaflets are available on the following link:

https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/hcai-amr-information-for-patients-and-public/patient-leaflets/

Details on communicating with patients to inform them that they have been identified as a CPE contact are outlined in the communication section of this guideline. People who are CPE contacts should have been given a small plastic card to show to healthcare workers to tell them that are a CPE contact (See Appendix 1)

CPE Screening

Screening for CPE generally means testing a rectal swab or sample of faeces for CPE by selective culture or by molecular methods. In some cases, additional samples may also be tested for CPE. CPE encompasses both population screening and screening in the context of contact tracing.

Testing of people for colonisation with CPE is performed on the basis that people are entitled to decline testing and to the greatest extent practical should be provided with relevant information about the testing offered.

Detection of asymptomatic colonisation with CPE is of benefit to the person identified as colonised because that knowledge may be critical to the choice of appropriate empirical antimicrobial treatment in the event that they develop serious infection. In general people colonised with CPE (no clinical evidence of infection) should not be treated with antibiotics. Antibiotics do not clear the colonisation from the gut and in fact are likely to make the colonisation more intense and last longer. Evidence that a person is at high risk of CPE colonisation but is not colonised is of benefit to the person because that knowledge may guide a treating clinician towards the use of narrower spectrum and safer antimicrobial therapy if they develop serious infection.

Detection of asymptomatic colonisation with CPE is of benefit to the wider community because it supports measures to control the spread of CPE in the acute hospital setting.

The following are critical issues in relation to the ethical conduct of a programme of screening for CPE:

1. Respect for the person's entitlement to refuse testing without prejudice to their access to care.
2. Respect for the entitlement of people identified as colonised with CPE to have the same regard for their privacy and the same level of access to health and social care services as are other people.
3. Respect for the person's right to information about their health. In the event that a person tests positive for CPE they should be informed promptly in accordance with recommendations as outlined in the communication section of this guidance.

Acute hospital setting screening

Screening for CPE should generally be performed as soon as possible after admission to an acute hospital. Where possible, samples should be submitted within the first 24 hours. It is recommended that the screening should take place at the time of admission or as soon as it is practicably possible. People in whom the requirement to offer screening is not recognised at the time of admission should be offered screening as soon as possible after the requirement is recognised.

Note, in some circumstances, samples from additional sites for testing for CPE may also be appropriate based on clinical assessment.

Collection of rectal swabs, rather than waiting for stool samples, lends itself to prompt sample collection and is generally preferred. If rectal swab sampling is not acceptable to a person, stool samples are high quality samples. Generally samples of faeces are appropriate for children.

Elective screening in acute hospital settings

If a hospital is using a system of pre-admission screening for elective procedures, a sample collected within the 7 days before the date of hospital admission can be accepted as equivalent to an admission screen.

Screening prior to transfer to other healthcare facilities

Healthcare facilities should not require CPE screening in advance of patient transfer between facilities. A requirement for pre-transfer screening is likely to delay patient transfer.

Population screening in acute hospitals

Population screening for CPE (that is CPE screening in people who are not CPE Contacts) generally involves a single sample at the beginning of each hospital admission. People with very frequent admission to a general hospital need not be screened on admission more frequently than once per week. In some circumstances population screening for CPE should involve additional testing for CPE at intervals during the hospital stay. For example, all people admitted to an Intensive Care Unit should be screened weekly for the duration of their stay in ICU.

Who Must be Included in Population Screening?

Two approaches to population screening can be taken within acute hospital settings. The hospital should conduct periodic audits to assess performance of their CPE screening programme.

Targeted population screening

The following people must be offered screening for CPE in acute hospitals:

a. All people who were transferred from any other hospital in Ireland or received healthcare abroad.

b. All people who have been inpatients in any hospital in Ireland or elsewhere any time in the previous twelve months. Any hospital includes previous admissions to the hospital to which they are now being admitted.

c. All people who normally reside in a long term care facility for older people

d. All admissions to and all transfers to Intensive Care Units and High Dependency Units on admission and weekly thereafter.

e. All admissions to and all transfers to haematology, oncology and transplant wards on admission and weekly thereafter.

f. People undergoing renal dialysis for the first time in a dialysis unit, periodically during dialysis treatment (preferably every three months but not less than every six months), and on return from dialysis elsewhere.

g. All people who were formerly colonised with CPE but who have subsequently met the criteria for removal of that designation.

h. Other people where CPE screening is requested by the IPC team.

Footnotes.

1. A key challenge for implementation is the ability to identify the people who should be offered screening readily. Information regarding inpatient stay in any other hospital in the previous 12 months and residence in a long -term care facility for older people should wherever possible be recorded routinely by the admissions office and should, whenever possible, be easy to obtain from the patient administration system

2. There is no evidence that the collection of rectal swabs represents a significant risk to people who are neutropenic. Undetected carriage of CPE may be a particular risk for these vulnerable people. Several recent publications report routine screening by rectal swab collection in haematology cohorts including bone marrow transplant recipients. These people should be included in screening programs.

2. Broader population screening

Broader population screening based on hospital risk assessment

Many hospitals have found that the effective identification of people in certain categories for targeted screening is very challenging in practice. Some hospitals have found it more practical to implement broader-based screening. Their experience is that this approach captures most of those people who would require CPE screening with the targeted approach (as per above). Such approaches consider offering of screening to all admissions, or to all emergency admissions. The approach taken must ensure that a high proportion of those risk groups identified in the above option are encompassed in the population offered screening. Broader population screening is generally not appropriate for children's hospitals or maternity hospitals or for discrete children's & maternity units in general hospitals. Where broad based screening of admissions (for example all admissions, or all emergency admissions) is implemented based on local risk assessment it is essential that the following elements of targeted CPE screening are also in place.

a. All admissions and transfers to critical care areas, Intensive Care Units and High Dependency Units on admission and weekly thereafter.

b. All admissions and transfers to haematology, oncology and transplant wards on admission and weekly thereafter.

c. People undergoing renal dialysis for the first time in a dialysis unit, periodically during dialysis treatment (preferably every three months but not less than every six months), and on return from dialysis elsewhere.

d. All people who were formerly colonised with CPE but who have subsequently met the criteria for removal of that designation.

e. Other people where CPE screening is requested by the IPC team.

Population Screening in Maternity Hospitals/ Units.

Targeted population screening for CPE is generally appropriate for maternity hospitals with the following qualifications

1. Pregnant women who have frequent admissions to the same maternity hospital/unit and who have no other indication for CPE screening need not be screened more frequently than once every three months.
2. Screening for CPE should generally be performed at intervals of less than three months if there has been an intervening admission to a general hospital or other specific risk factors apply, for example, recent hospitalisation outside of Ireland.
3. Infants transferred between neonatal intensive care units should be screened for CPE on admission to the NICU.
4. More limited screening for CPE may be justified where a documented local risk assessment by the IPC team indicates that the risk of CPE colonisation is very low and there is no evidence of CPE transmission in the hospital. Any such risk assessment should be reviewed at least annually.

CPE Screening in Children's Hospitals/ Units. Targeted screening for CPE (Option 1 above) is generally appropriate for Children's Hospitals with the following qualifications:

1. Children who have frequent admissions to the same hospital/unit and who have no other indication for CPE screening need not be screened more frequently than once every three months.
2. Screening for CPE should generally be performed at intervals of less than three months if specific risk factors apply for example recent hospitalisation outside of Ireland.
3. More limited screening for CPE may be justified where a documented local risk assessment by the IPC team indicates that the risk of CPE colonisation is very low and there is no evidence of CPE transmission in the hospital.
4. Any such risk assessment should be reviewed at least annually.
5. In general no CPE screening is required in relation to an infant born to a woman who is known to be CPE positive if the infant is largely in the care of its parents while in hospital and is promptly discharged to home. The infant need not be designated a CPE Contact. If an infant born to a CPE positive woman is admitted to a Neonatal Intensive Care Unit CPE screening should be offered on admission and weekly thereafter for the duration of the infant's stay in NICU.

CPE Screening in the Context of Contact Tracing

CPE Contacts are people assessed by IPC professionals or public health doctors as having had a specific exposure(s) that places them at higher risk of having CPE colonisation or infection.

Screening of CPE Contacts in the acute hospital setting should commence promptly. Samples should be taken at intervals of at least one week apart. The last sample should be taken at least four weeks after the latest date of exposure. When an interval of time has elapsed between the latest date of exposure and commencement of screening, the intervals between sampling may be reduced. However the final sample should be taken at least four weeks after the latest date of exposure.

When does a Contact Cease to be a Contact?

A person may be considered as no longer a CPE contact if they have at least four samples reported as CPE not detected and if more than four weeks have elapsed since the latest date of the identified exposure. After the designation of CPE contact has been removed from a person's record the person should still be included in population screening for CPE on the same basis as other people.

Screening for CPE outside of the acute hospital setting

Although screening for CPE is not required outside of the acute hospital setting it may be appropriate to facilitate CPE screening for some people in the non-acute hospital setting. It is appropriate to facilitate people identified as CPE contacts who have left hospital but who wish to be tested for CPE. It may be pragmatic to offer screening to CPE contacts who are likely to require readmission to an acute hospital in the short term. It may be pragmatic in certain circumstances to offer pre-admission CPE screening to certain non-CPE contacts in advance of planned admission to an acute hospital. These arrangements may support appropriate patient placement at the time of admission. Any processes for pre-admission CPE screening implemented must operate to facilitate access to hospital care and must not delay access to care.

Patient accommodation

What is meant by isolation in the context of Infection Prevention and Control?

Isolation refers to the accommodation of one patient in a single room, ideally with en-suite toilet and bathing facilities together with the application of specific transmission-based IPC precautions to reduce the risk of spread of organisms from the person in the single room.

If a single room does not have access to a dedicated toilet, a commode should be dedicated to that room and decontaminated after each patient use. The commode must be in good condition so that it can be cleaned effectively.

Note: Wherever possible, the equipment to be used for the care of the patient in isolation should be single-use or dedicated for that patient's use only, for example, blood pressure cuff, stethoscope.

What is meant by cohorting in the context of CPE and Infection Prevention and Control?

Cohorting refers to the accommodation of two or more patients in a space that they share with each other, but which is separate from the space used by other patients. It is important to emphasise that within a cohort area, transmission-based IPC precautions (specifically contact precautions) must be applied when moving between patients within the cohort area.

Acute Hospital setting – accommodation for patients with CPE colonisation / infection

It is recommended that patients with CPE in an acute hospital are accommodated in an isolation room with an en-suite toilet and bathing facilities. If this is not possible the patient should be accommodated in a single patient room with dedicated commode.

Where there are multiple patients with CPE it is recommended that they should be placed in single rooms in proximity to each other on one ward. This minimises risk of dissemination in the event of lapse in infection control practice. It is accepted that there may be exceptional circumstances where this is not clinically appropriate or where it is not possible because of hospital infrastructure.

Where placement in a single en-suite room is not possible, a patient with CPE may be placed in a designated multi-bed cohort area along with other patients with CPE of the same CPE type.

Note: that contact precautions are required when moving between patients in a cohort area. If patients in cohort areas develop other conditions that require single room isolation in their own right (for example acute diarrhoea) they should be moved from the cohort area to a single room as quickly as possible.

It is recommended that patients who do not have confirmed CPE colonisation should **NOT** be cohorted with patients with confirmed CPE colonisation or infection.

It is recommended that patients with CPE should **NOT** be cohorted with other patients with CPE if they have different types of CPE. For example, a patient with an OXA-48 CPE should not be cohorted with a patient with an NDM CPE.

Recommended nurse/healthcare worker allocations for the care with CPE:

It is recommended that one-to-one care is not generally required for care of patients with CPE provided there is adequate staffing to allow staff to comply fully with contact precautions.

Patients who are colonised or infected with CPE and who require high levels of personal care (for example patients with disturbed behaviour or very high levels of dependency) should, wherever possible, be cared for by nursing and healthcare assistant staff who are not engaged with the care of non-CPE patients for the duration of their duty shift.

If CPE patients are in single rooms/ cohort areas are in close proximity on a single ward area this reduces risk associated with staff caring for multiple patients during a shift.

Cohorting in acute hospital settings

Cohorted patients should have separate toilet and bathing facilities restricted to use by the patients in the cohort. One toilet per four cohorted patients is the minimum acceptable.

When a cohort of patients must share toilet facilities with each other, the toilets must be cleaned at least 4 times per day between 6 am and midnight and whenever they are noted to be visibly dirty. In addition, patients should have access to cleaning wipes so that they may wipe surfaces before use should they wish to do so. Access to wipes is not a substitute for scheduled adequate cleaning but is intended as an additional measure to empower patients who wish have an assurance that the surfaces they have contact with are clean. Patients should be advised on how to discard these items to ensure that they do not cause blockages to the systems.

If a cohort area does not have access to a toilet dedicated to use by the cohort, a commode should be dedicated to each patient in the cohort area and decontaminated after each patient use.

Cohort areas should have adequate spacing between beds, (a minimum distance of 1m is required from edge of bed/trolley to edge of bed/trolley). When choosing a cohort area, the multi-bedded

area chosen should ensure adequate space. An area with the minimum number of beds required to accommodate the cohort should be chosen to minimise the number of unused beds.

Community and RCF settings

In residential care facilities, in larger facilities with more than one resident with CPE, the rooms / bed spaces of the residents with CPE should be grouped in the same area of the facility. If possible they should be cared for by the same staff and they should use the same toilet. If possible the same dirty utility area should be used for all these residents.

Note: Equipment, for example commodes, blood pressure cuff and stethoscope, used for cohorted patients should be single-use or individual patient use only. If this is not feasible, for example, for larger items, equipment should be dedicated to the cohort area and must be cleaned and decontaminated after each patient use.

Inpatient accommodation acute hospital setting for CPE contacts

It is recommended that patients identified as CPE contacts who need to remain in hospital should ideally be accommodated as for patients with CPE colonisation with the following qualifications.

Patients identified as CPE Contacts should not be cohorted with patients with colonisation or infection with CPE.

Patients identified as CPE Contact patients do not require the same priority for isolation as patients with CPE colonisation or infection.

The priority for isolation of a patient identified as a CPE Contact can be lowered if the patient has had 1 or more CPE samples tested and reported as CPE not-detected.

If CPE is detected from a CPE Contact patient in a CPE Contact cohort area they must be transferred out of the CPE contact cohort area to a single room with ensuite toilet and bathing facilities, or a cohort area for patients with the same category of CPE as quickly as possible. The guidance for a patient with CPE colonisation or infection then applies.

Communication

The findings of the National Inpatient Experience 2021 highlight the need to continue to improve communication between healthcare staff and patients. Over 50% of people said that they did not or did not always find someone on the hospital staff to talk about their worries and fears.

Communication with service users must be compassionate, truthful, timely, and clear. If things go wrong, the person must be told in a timely, open, compassionate, and honest manner. This applies to all patient safety incidents or adverse events. The HSE Open Disclosure policy provides guidance for all healthcare staff. Refer to guidance on open disclosure on the following link: https://www.hse.ie/eng/about/who/nqpsd/qps-incident-management/open-disclosure/hse-open-disclosure-full-policy.pdf

It is important to recognise that patients may find it difficult to understand what has happened and may have many questions about their healthcare infection diagnosis. At times patients may not have any questions as they may not have taken in the information. It is important to give the diagnosis in plain English and refrain from using medical jargon. Check that the patient understands what has been discussed by asking them about it. Please speak in a calm and empathetic way, you may be fully aware that the HCAI diagnosis may not be a life altering one but talking about superbugs and infections can be very worrying for the patient. Patients and/or their support person may want to talk to you a later date about their diagnosis and treatment.

The requirements for communication with patients with CPE and CPE contacts are outlined in "Discussing healthcare associated infection (HCAI) and specific antimicrobial resistant organisms (AMROs) with patients"

https://www.hpsc.ie/az/microbiologyantimicrobialresistance/strategyforthecontrolofantimicrobialresistanceinirelandsari/carbapenemresistantenterobacteriaceaecre/guidanceandpublications/Discussing%20HCAI_AMROs%20with%20patients_final_2July18.pdf

Please make sure you provide the patient with the relevant AMRIC patient leaflet, these can be ordered through www.healthpromotion.ie from November 2022. There are printed leaflets relating to several HCAIs including CPE.

People who are colonised with CPE should be given a small plastic card to show to healthcare workers to tell them that are a CPE contact. This card is illustrated in the Appendix 1 to this document.

Communication regarding inter-facility transfer of patients colonised or infected with antimicrobial resistant organisms (AMRO) including Carbapenemase Producing Enterobacteriaceae (CPE)

Each patient colonised with an AMRO is entitled to receive the best care that the healthcare service can reasonably provide to them and in a location that in so far as possible is reasonable in relation to sustaining their connection with their sense of place and community. It is unethical to deny patients access to any healthcare facility or to make them accept unreasonable delays in access to a health care facility unless there is a compelling public health justification for doing so.

Measures to manage the risk of dissemination associated with AMRO must be balanced with the imperative of delivering appropriate care to patients in a timely manner and in a location that takes reasonable account of their need to belong to a community and to have access to family and friends. Transfer of patients between services (for example, between acute hospitals, from acute hospital to primary care or from acute hospital to residential care) requires advance and clearly documented communication with patient transport services and the receiving service. The receiving service must take all practical measures to minimise the risk of transmission.

Managing Transfer of Patients

Communication

Any transfer of patients between facilities should be preceded by clear communication. The communication should be initiated by the sending facility and should include all relevant IPC information including any known colonisation/infection with AMRO, any known concern regarding contact with AMRO and any aspects of the patient's condition (physical or behavioural) that are likely to be relevant to managing IPC related risks. In the case of transfers of patients with specific identified AMRO related risks (infected/colonised/contact) between acute hospitals a nurse manager in the sending facility (usually the ward manager) should contact the relevant nurse manager in the receiving facility in advance of transfer. In addition to pre-transfer communication all relevant details should also be included in the written communication from both medical and nursing teams that accompanies the patient. Communication should use appropriate channels that protect the patients' privacy. If the medical or nursing staff of the sending facility become aware of any new important information related to the IPC status of a patient after the patient has transferred the doctor or nurse receiving the information is responsible for ensuring that the

information is communicated to the relevant medical or nursing staff in the RF at latest on the next working day and immediately if the situation requires.

If the medical or nursing staff in the receiving facility identify significant omissions in relation to IPC related information provided in respect of a patient transferred, they should inform senior clinical staff in the sending facility.

Timing of Transfer

Urgent Transfers

Concerns regarding known or suspected colonisation or infection with contact transmitted AMRO including CPE may not be allowed to delay urgent transfers that are essential to patient care. Even if facilities in the receiving facility are not optimal the patient should be transferred promptly and the receiving facility should implement all practical measures to mitigate risk within the constraints that apply.

Non-urgent Transfers

Inter-facility transfers should not be delayed pending the performance of AMRO screening or receipt of AMRO screening results. Where screening is required the receiving facility should accept the patient, apply appropriate IPC precautions and perform such screening as is required after receipt of the patient. In the context of concerns regarding known colonisation/infection with AMRO including CPE some delay in non-urgent transfer may be reasonable in order to facilitate access to better facilities (e.g. a single room or bed in a cohort are likely to become available) and or planning and implementation of measures to mitigate risk in sub-optimal facilities. This delay should not normally exceed two working days. Any delays in patient transfer related to AMRO including CPE should be disclosed to the patient and if appropriate with family or carers in accordance with HSE policies on open disclosure.

Visitors in healthcare settings

There should be no restrictions on visiting related to colonisation with CPE or other MDRO. Relatives and friends should not be required to wear personal protective equipment when visiting patients who are colonised with CPE or deemed a CPE contact. They should be encouraged to perform hand hygiene before and at the end of each visit.

If personal care is given, it may be appropriate to wear PPE (as per Point of care risk assessment). Visitors should be advised how to put on and take off PPE with the support of healthcare staff and advised to perform hand hygiene following removal. Refer to local visiting arrangements for individual areas.

Healthcare Workers (Acute Hospital and Community) identified as colonised with CPE or identified as CPE contacts

Healthcare workers colonised or infected with CPE are entitled to continue to practice their profession with the minimum restrictions on their practice that are considered necessary to ensure patient safety. In most cases healthcare workers can continue to practice with minimal risk of spread of CPE provided the healthcare worker complies with good infection prevention and control practice.

What is the risk to people receiving healthcare from healthcare workers colonised or infected with CPE or who are identified as CPE contacts?

As CPE and other gut colonising bacteria live in the gut and are shed in faeces there is no reason to expect that there is a high risk of spread of CPE from a healthcare professional who is in good health, who performs careful hand hygiene after attending the toilet and who observes generally accepted patterns of behaviour for working in a health care environment (Standard Precautions**).**

Healthcare workers with clinical evidence of infection should not be involved in direct patient care until they have fully recovered from their illness. This general principle applies equally to infection with CPE, as it does to infections not caused by Anti microbial resistant organisms (AMRO).

Screening of healthcare workers for colonisation with CPE is not usually recommended as an infection prevention and control measure because there is little evidence to suggest that it helps to prevent spread of CPE.

Screening of healthcare workers for colonisation with CPE, as an infection prevention and control measure may be appropriate in very exceptional circumstances. This may arise where there is evidence of transmission of CPE in a healthcare facility and the epidemiological and/or

microbiological evidence gives rise to a reasonable hypothesis that a healthcare worker may be the source of spread. In such circumstances the reason for recommending screening should be explained to staff members and screening should be arranged through Occupational Health services to ensure appropriate care and confidentiality for the healthcare workers tested.

The standard criteria for identifying people who require CPE screening apply equally to healthcare workers as to others. There is no additional requirement screening related to their occupation.

Restriction of the scope of practice of a healthcare worker colonised with CPE is generally not required.

A healthcare worked colonised with CPE should be conscious of the need for scrupulous compliance with Standard Precautions. They should be conscious of the need to avoid work during any period of acute infectious disease and any episode of gastrointestinal disturbance associated with diarrhoea. They must avail of infection prevention and control training as required.

A healthcare worker colonised with CPE should declare their status to the Occupational Health Department. The Occupational Health Service and the Infection Prevention and Control team should liaise with each other as necessary with due regard to right to privacy and confidentiality of the healthcare worker.

Indications regarding the status of healthcare workers as a person colonised with CPE should be managed on the Patient Information Management systems and Infection Prevention and Control Management systems on the same basis as other people.

Specialist areas

Palliative care settings

It is not appropriate to adopt a generic approach to IPC for all palliative care settings. The following is recommended with respect to in-patient palliative/residential palliative care settings:

1. In all healthcare settings, Infection Prevention and Control (IPC) practice must be applied with due regard to the needs of the individual patient and their family

and friends. This requirement merits attention in the context of palliative care in general and in particular in the context of end-of-life care.

2. Each in-patient/residential palliative care centre should evaluate the intensity of care delivered in the centre and within each discrete section of the centre to determine if the intensity of care is most closely similar to an acute hospital or most similar to a community hospital/long-term care facility. It may be that individual sections within a centre should be categorised differently.
3. CPE screening and other MDRO screening should generally not be performed in the context of end-of-life care.
4. Relatives and friends should not be required to wear personal protective equipment but should be encouraged to perform hand hygiene at the end of a visit.
5. There should be no restrictions on visiting related to colonisation with CPE or other MDRO.
6. No IPC restrictions should be placed on having flowers or other items that provide comfort in the person's room (as per individual local healthcare facility recommendations).
7. Strict source isolation should rarely if ever be implemented.
8. In relation to floor coverings, furniture and fittings, flexibility may be required in relation to comfort and noise control *versus* the ease of cleaning, in particular in the context of end-of-life care.
9. In relation to cleaning schedules – it may be appropriate to modify cleaning schedules to minimise intrusion in certain clinical settings, a risk assessment approach should be applied in this situation.

Haemodialysis

Chronic haemodialysis poses particular IPC challenges. Patients undergoing chronic haemodialysis have frequent relatively intense contact with healthcare services over months or years. This results in very frequent, relatively brief but intense contacts with other patients, healthcare workers and healthcare environments that can act as sources for transmission of infectious organisms, including CPE. In general, haemodialysis services in Ireland contain multi-bed open space rooms with limited numbers of single rooms and often limited toilet facilities.

Haemodialysis patients are more vulnerable to infection than most people because of the renal failure and because of requirements for permanent vascular access to support renal replacement therapy. Patients may undergo renal transplantation which is supported by immuno-suppressive therapy that may also increase their vulnerability to infection with AMRO acquired when on haemodialysis treatment.

In addition to the risks associated with their primary haemodialysis centre, haemodialysis patients are exposed to risks of acquisition of AMRO when they require access to haemodialysis services in other parts of Ireland and outside of Ireland when they travel. The requirement to access other haemodialysis services is associated with a risk that if an AMRO becomes established in one haemodialysis centre that centre may serve as a focus for dissemination of the organism to other centres carried by patients who have visited that centre. A further issue in relation to haemodialysis services is the potential for the transfer of organisms from person-to-person in the context of shared transport between home and haemodialysis centres.

Because of the duration and intensity of contact with healthcare services, patient education is of particular value in renal haemodialysis settings. All haemodialysis patients should be provided with information regarding the risk of acquiring AMRO in healthcare settings and the practical steps that they can take to reduce their risk. Refer to https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/hcai-amr-information-for-patients-and-public/patient-leaflets/ for leaflets on being infection aware.
All haemodialysis patients should be provided with hand hygiene training unless they are unable to participate in or benefit from this training. All patients should be supported in performing hand hygiene after using the toilet and before eating. On completion of haemodialysis all patients should be supported in performing hand hygiene before leaving the haemodialysis centre.

The principles of application of **Contact Precautions** in haemodialysis services are as in other aspects of acute hospital services but their application occurs in a particular context that may be challenging. In particular, there may be limited access to single patient rooms that are suitable for all patients. In so far as is practical, people who are CPE colonised and CPE Contacts, should undergo haemodialysis treatment in single patient rooms. This is particularly important with patients that have diarrhoea or other conditions or behaviours that make containment of faecal matter particularly difficult with the likelihood of significant contamination of the healthcare environment.

For most patients undergoing haemodialysis, **Contact Precautions** can be applied in an open area if single patient room accommodation is not available. Implementing **Contact Precautions** in an open space in a haemodialysis unit, in particular donning and doffing long sleeved gowns, may be stigmatising and may compromise patient confidentiality. The risk may be managed in accordance with point of care risk assessment, refer to https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/infectioncontrolandhai/posters/

The patient's bed space should undergo terminal cleaning and decontamination after the patient has completed haemodialysis, as a standard.

Travel to and from Haemodialysis Services

People colonised with CPE or other gut colonising microorganisms may generally travel in the same vehicle as other patients to and from haemodialysis services.

Evidence of Transmission of CPE in a Haemodialysis Service

Regular screening of all haemodialysis patients for CPE as recommended above is critical to ensure the transmission of CPE associated with a haemodialysis service is detected rapidly and this in turns facilitates interventions to minimise subsequent spread. In the event of evidence of transmission of CPE in a haemodialysis service an outbreak control team should be convened and the Medical Officer of Health notified in conformance with legislation. In the context of evidence of transmission there is a requirement for enhanced IPC precautions.

Screening

CPE screening is required for people undergoing haemodialysis for the first time in a haemodialysis unit, periodically during haemodialysis treatment (preferably every three months but not less than every six months), and on return from haemodialysis elsewhere, especially abroad. This is part of a comprehensive screening programme for infectious agents including blood borne viruses and other antimicrobial resistant organisms required in haemodialysis services.

Hospital Out-Patient, Day Care and Primary care services

Out-Patient Attendance (including ante-natal care)

Before attending

People colonised with AMRO should be scheduled for care on the same basis as other people. They should not be required to attend last at the clinic and should not generally be put "last on the list" for day case procedures.

All people, but especially those known as colonised with CPE should be encouraged to clean their hands regularly.

Reception and Waiting Room

People colonised with CPE should not be segregated from other people at reception or in the general waiting area where they are sitting fully dressed.

People colonised with CPE do not generally require segregated toilet facilities in the waiting area. As in all healthcare settings there should be adequate toilets. Toilets in hospital reception and waiting areas should be cleaned at regular intervals, as per cleaning protocols. At a minimum toilets should be cleaned once during the day (ideally around mid-day to capture peak activity periods in outpatient settings) and at the end of each day that the facility is in use. In addition toilets should be cleaned promptly at any time if staff become aware that the toilet is soiled.

Where care is delivered

In some settings where people have relatively long stays in treatment areas providing services to extremely vulnerable people (for example haematology and oncology day treatment wards) a designated toilet for use by known CPE colonised people should be considered as essential. Access may be controlled by code provided to relevant people and staff. Where this is not possible in the day care area these people should receive treatment in an appropriate room in the hospital in-patient area.

In general no specific measures are required with respect to people colonised with CPE who are engaging in group classes or rehabilitation activities provided they are continent, full dressed and do not have any behavioural disturbance.

PPE in the context of Outpatient settings /Day Care services/Primary care

If there is significant physical contact with the person, for example physical examination of an undressed patient, the healthcare worker should use personal protective equipment such as an apron where required. Gloves may also be required in some settings for example when contact with blood, body fluids or indwelling devices is likely. When apron and or gloves are used they should be disposed of immediately after use. Hand hygiene should always be performed after gloves are removed.

It is not necessary to cover chairs in the examination room if the person is sitting fully clothed.

Standard and transmission based precautions in the context of Outpatient settings /Day Care services/Primary care

As with all people, if the person is undressed for examination, examination couches should be covered with a disposable cover that is disposed of immediately after use. There is no requirement for further cleaning of the couch between people unless there is visible contamination.

Where re-usable equipment for example a stethoscope is used those elements of the equipment in contact with the person's skin should be decontaminated with an appropriate disinfectant immediately after use.

Unless it is likely to interfere significantly with clinical evaluation of the person's blood pressure, blood pressure cuffs should generally be applied over light clothing (such as a shirt sleeve) to minimise contamination from direct contact with skin. Where this is not possible disposable covers for the cuffs may be appropriate. In larger out-patient areas or clinics caring for a high proportion of AMRO colonised or infected people it may be practical to set aside a particular room for care of AMRO colonised or infected people.

Environmental Cleaning in the outpatient/day care services/primary care settings

Any surface in a clinical area that the person has had direct contact with while undressed should be cleaned and disinfected immediately after the person leaves the room and before it is used for another person. There is no requirement for increased frequency of cleaning of floors walls and other non-contact surfaces after an examination room is used for a patient with CPE unless there is visible soiling or there was a significant incident of body fluid contamination. Provided the person is continent, fully dressed, has no behavioural disturbance and is supported as necessary in performing correct hand hygiene and dressing after visiting the toilet, the risk of person-to -person spread and environmental contamination is low.

Operating Theatres

Transfer of patients who are colonised with CPE to operating theatre requires advance and clearly documented communication with the person in charge/nurse manager of the receiving department, who in turn must ensure adequate precautions and an up-to-date local policy are followed to minimise the risk of transmission. There should not be undue delays in patient access to surgical interventions attributable to their CPE status. Standard and transmission based precautions apply, as outlined previously. Standard cleaning and disinfection should take place as per standard practice.

Radiology

Transfer of patients who are colonised with CPE to radiology requires advance and clearly documented communication with the person in charge of the receiving department, who in turn must ensure adequate precautions and an up-to-date local policy are followed to minimise the risk of transmission. There should not be undue delays in patient access to investigations or interventions attributable to their CPE status. Standard and transmission based precautions apply, as outlined previously. Standard cleaning and disinfection should take place as a norm.

Laboratory

Laboratory screening for CPE should at a minimum mean plating of rectal swabs/faeces on one of the accepted CPE chromogenic agars. Access to rapid methods for direct testing of selected samples and/or for rapid confirmation of suspect CPE from agar plates should be available. Where screening is based on an initial molecular method those samples that test positive should be cultured to attempt to isolate the organism. It is accepted that in some instances it will not be possible to confirm a molecular result by culture. If the molecular test used is a CE (European Conformity) marked product or a well validated in-house method, this result is generally sufficient to designate the patient as CPE colonised though consideration should be given to culturing subsequent samples to obtain culture confirmation whenever possible. Where capacity to perform screening does not exist in each individual hospital laboratory, hospital groups may consider providing the testing from one centralised laboratory or from a limited number of laboratories if this is a more effective use of resources. Laboratories should have arrangements for processing samples daily or sending samples for processing daily including over weekends. The first isolate of any bacterial species or CPE genetic type from a patient should be sent to the National Reference Laboratory Service. It is acknowledged no isolate is available for sending in the event that CPE is detected by molecular methods but not confirmed by culture.

Key recommendations for laboratory testing

Culture based and direct molecular detection methods are both suitable for detection of CPE in clinical samples.

Laboratories should consider turnaround time, cost, workflow and timeliness of support for patient placement decisions in choosing a method.

On-site access to very rapid turn-around molecular testing of selected individual patients for CPE is valuable to support appropriate patient placement decisions in both laboratories using culture

based detection and those using direct molecular testing using high-throughput batch testing platforms.

Laboratories should report the majority of samples on the day after receipt of the sample including those received over weekends and holiday periods.

When using culture based methods, rapid detection of carbapenemase antigen and or rapid detection of carbapenemase genes by nucleic acid amplification technology should be applied promptly to suspect CPE colonies to identify the more common types of CPE.

In general there is no requirement to perform additional testing on most non Enterobacterales that grow from screening samples on CPE selective chromogenic agar.

Periodic or selective testing of *Acinetobacter* spp. that grow from screening samples on CPE selective chromogenic agar for carbapenemase antigen/ transferrable carbapenemase genes, should be considered in samples from high risk units such as Intensive Care Units.

Testing of all *Acinetobacter* spp. that grow from screening samples on CPE selective chromogenic agar for carbapenemase antigen/ transferrable carbapenemase genes may be appropriate for a period of time in hospitals that have identified such isolates from clinical samples or the environment.

When using direct molecular testing methods all newly detected positive patients should be confirmed by culture of CPE if at all possible.

People who test positive by direct molecular methods but from whom CPE cannot be cultured are not notifiable under the case definition for CPE.

Communication with primary teams and patients regarding patients with a positive direct molecular test that is not subsequently confirmed by culture must be clear in relation to how the result should be interpreted.

In relation to circumstances in which CPE is not confirmed by culture; people that have an unequivocal and reproducible positive molecular test on a single or multiple samples by a single molecular method should be identified as **possible CPE** and managed in the acute hospital as for CPE positive patients pending further evaluation.

In relation to circumstances in which CPE is not confirmed by culture, people that have a non-reproducible positive direct molecular test on a single sample should generally not be regarded as CPE positive and should not be managed in the acute hospital as for CPE positive patients.

In relation to meropenem susceptibility testing of isolates, the approach used should be capable of differentiating between meropenem wild type and meropenem non- wild-type Enterobacterales. Test methods that are limited to differentiation between meropenem susceptible and meropenem non-susceptible isolates are not sufficient.

First detected CPE isolates from any patient, all CPE invasive isolates (from normally sterile body site) and suspect CPE isolates (as defined in the National CPE Reference Laboratory Service user guide) should be submitted to the reference laboratory within a week of isolation. (See reference laboratory user guide.)

Direct molecular detection is not recommended for application to environmental samples.

Laboratory Detection of CPE

There are two general approaches to detection of organisms in clinical samples. Recovery of a viable organism in pure culture has been the long established and definitive method for establishing the presence of an organism in a sample. In recent years an alternative approach based on culture independent direct detection of specific antigens or nucleic acid has become widely used. Culture independent methods have certain advantages but also some limitations.

An evaluation of the relative merits of culture based methods compared with molecular methods as the primary test for detection of CPE in screening samples is beyond the scope of this guidance. Culture based methods are widely used as the primary method of screening CPE. Planning for implementation of the national CPE screening guidance was based on the assumption of culture based screening in most settings. However, supplementary use of rapid molecular detection of CPE for selected circumstances is valuable. Furthermore some hospitals have determined that direct use of molecular testing is appropriate as the primary method for CPE screening in their setting. Therefore direct molecular testing of samples for CPE in Ireland is relatively common and some guidance on the confirmation of results from samples subject to direct molecular testing is required.

Detected /Not-Detected

The ability to detect a microorganism in a sample is dependent on the quality of the sample received in the laboratory and on the methods applied to detect the organism. There is no process of testing that can guarantee detection of CPE in all people who carry CPE. Therefore test results, culture based or direct molecular, are best reported as “detected” when CPE is identified and as “not-detected” when CPE is not identified. “Not-detected” is not equivalent to negative.

There are broadly speaking two categories of clinical samples from which CPE may be detected.

Diagnostic Samples

Diagnostic samples are collected from a specific site because there is a concern, based on clinical features, that an organism at that site may be associated with infection. The sample collected is typically cultured on a variety of culture media including non-selective culture media. The process is intended to support the growth of a wide range of microorganisms.

After a period of incubation and an assessment of the culture media for growth, relevant organisms (colonies) may be selected for identification, rapid testing for carbapenemase enzymes/genes and for antimicrobial susceptibility testing.

CPE Screening Samples

CPE screening samples are generally collected from patients based on national guidance. The test is not requested based on a clinical suspicion of infection. The process is intended to identify patients with asymptomatic gut colonisation with CPE. This supports the implementation of additional infection prevention and control precautions and may inform choice of antimicrobial therapy if the patient subsequently develops infection.

Culture Based Detection of CPE from CPE Screening Samples

Detection of CPE from CPE screening samples is generally based on culture on selective and differential media (usually chromogenic culture media). These culture media are designed to favour growth of CPE and discourage growth of other bacteria.

The samples may be cultured directly on selective media or may be subject to initial enrichment in a broth containing a carbapenem prior to culture on selective agar.

Culture based detection requires a minimum of 16 hours from receipt of sample to detection of colonies of microorganisms that represent suspect CPE. In some cases the colonies may not appear for 48 hours. From the time of identification of suspect colonies, most common CPE can be identified with sufficient confidence for clinical decision making within minutes to hours. This is based on confirmation that the colony is a member of the order Enterobacterales and rapid identification of suspect colonies as CPE is by testing of the colonies for carbapenemase specific antigens (immunochromographic lateral flow) or carbapenemase genes. Based on positive results by these methods a patient can be considered CPE “detected” for immediate clinical decision making and for notification as CPE.

Some less common types of CPE that grow on chromogenic agar may be undetectable by available antigen detection and rapid molecular methods Therefore suspect CPE colonies that are members of the order Enterobacterales but are not confirmed as CPE by the rapid antigen or rapid molecular methods should be tested for susceptibility to meropenem by a method that differentiates between wild-type and non-wild-type for meropenem. Isolates that are wild-type for meropenem susceptibility do not require further testing.

CPE isolates identified from patients not previously identified as CPE positive should be sent to the National CPE Reference Laboratory service for confirmation. Those isolates that are Enterobacterales and are meropenem non wild-type should be submitted to the National CPE reference laboratory service for further testing.

Culture of Bacteria Other than Enterobacterales on CPE Selective Agar

Bacteria other that members of the order Enterobacterales may grow on CPE selective agar.

In some cases these will be species that have intrinsic resistance to meropenem (for example *Stenotrophomonas maltophilia*). These isolates generally do not require further testing however it is worth noting that transferrable CPE (for example VIM) have been detected in *Stenotrophomonas maltophilia*.

In some cases these will be species such as *Pseudomonas aeruginosa* which readily acquire meropenem resistance due to porin loss and which are rarely carbapenemase producers. In general these isolates do not require further testing. *Pseudomonas* spp. producing transferrable carbapenemase have been detected in very low numbers to date in Ireland. Further testing may be appropriate in a context of suspected transmission of multi- drug resistant organism of this species.

In some cases these will be *Acinetobacter* spp. Isolates of *Acinetobacter* spp. producing transferrable carbapenemase have been detected in a number of hospitals in Ireland. These organisms are not CPE, because they are not members of the order Enterobacterales. However they can represent a very serious risk to patients.

Periodic or selective testing of certain non Enterobacterales such as *Acinetobacter* spp. and *Pseudomonas* spp. that grow from screening samples on CPE selective chromogenic agar for carbapenemase antigen/transferrable carbapenemase genes should be considered in samples from high risk units such as Intensive Care Units. Testing of all *Acinetobacter* spp. that grow from screening samples on CPE selective chromogenic agar for carbapenemase antigen/transferrable carbapenemase genes may be appropriate for a period of time in hospitals that have identified

such isolates from clinical samples or the environment. *Acinteobacter* spp. that are identified as carbapemase producers by rapid testing methods or that demonstrate high-level resistance to meropenem should be submitted to the CPE reference laboratory service. *Acinetobacter* spp. that produce a transferrable carbapenemase may be notified as novel or rare antimicrobial resistant organisms.

Direct Molecular Detection of CPE from CPE Screening Samples

Direct detection of CPE by molecular methods may allow for detection of CPE within as little as two hours of receipt of a sample in the laboratory. This is possible with testing formats that facilitate immediate processing of individual samples. Certain other formats of molecular testing are designed to test a large batch of samples. With batch processing formats the processing time may be hours but there is generally a lag time between receipt of a sample and having sufficient samples to commence running a batch.

Direct Molecular Detection

Direct molecular detection of one of the common CPE genes in a clinical sample is a sufficient basis for making immediate clinical decisions including application of Contact Precautions. Direct molecular detection is not a basis for notification of a person as CPE positive.

When a person tests positive for CPE by direct molecular methods every reasonable effort should be made to achieve confirmation by culture.

The positive sample should be cultured on selective agar plates directly or following broth enrichment. If CPE is recovered by culture from any sample the person in question is confirmed CPE positive.

If CPE is not recovered on culture and the initial direct molecular detection is not reproducible the person should be regarded as CPE ”not detected”.

If CPE is not cultured from the original sample but direct molecular test is reproducible at least one and preferably two subsequent samples should be obtained from the person at intervals of at least 24 hours. Additional samples should be examined by direct molecular testing and culture with enrichment.

If CPE is not recovered on culture from any sample but samples from the patient are consistently positive on molecular testing the person should be regarded as likely CPE positive. Contact Precautions are appropriate in the acute hospital setting but the person does not meet criteria for notification.

Potential Explanations for Positive Test Result on Direct Detection of CPE in the Absence of Culture Confirmation

1. False Positive. (CPE is not present)

Molecular detection in absence of culture confirmation is potentially explained by a positive test result in the absence of the specific gene(s) that the assay is intended to detect. This could occur in the presence of a DNA fragment that is similar in some respects to the target nucleotide sequence but does not encode for the carbapenemase enzyme of interest.

2. True Positive (CPE is not present)

The target gene is present in a member of the Enterobacterales but culture has failed to isolate the organism. This potentially could occur because (a) the molecular test is capable of detection of CPE at lower levels than culture or (b) CPE is present at a very low level and by chance the organism is present in the material submitted to molecular testing but not in the material submitted to culture based detection (c) because CPE is present in significant numbers but the CPE is producing carbapenemase at a level that is too low to allow the organism to grow in or on selective culture media containing a carbapenem antimicrobial.

3. Detection of Target Gene in Absence of Target Organism (CPE is not present) Molecular detection in absence of culture confirmation is potentially explained by a detection of the target gene where the gene is in an organism other than a member of the Enterobacterales. This could occur in the presence of an environmental organism for example *Shewanella spp.* in which a target gene may be intrinsic.

Testing of Samples from the Healthcare Environment for CPE

Testing of the healthcare environment for CPE has become increasingly important in identifying sources of spread of CPE. Environmental samples should be collected using systems intended for sampling the environment. Environmental samples should be subjected to broth enrichment before subculture to selective agar plates. Following subculture to selective agar plates the processes applied are similar to those for culture of clinical samples. Direct molecular detection should not be applied to environmental samples as the systems marketed are not validated for this application and interpretation is likely to be difficult.

Refer to Appendices 2-7 for detail on laboratory testing methods.

Antimicrobial Stewardship

This section applies to for acute hospitals and RCFs together as many of the recommendations are relevant to both settings. Antimicrobial use is the key driver of antimicrobial resistance. To limit, and hopefully reverse, the increasing trends of antimicrobial resistance, a reduction in antimicrobial use is required. When an antimicrobial is required for a service user then the antimicrobial used and its duration should be chosen wisely. This process of using antimicrobials wisely is referred to as antimicrobial stewardship (AMS). AMS promotes maximising the benefit of antimicrobials and causing the least harm for the individual service user. Harms caused by the antimicrobial for the service user can include adverse effects from the antimicrobial, development of antimicrobial resistance and *Clostridioides difficile* infection. AMS programmes are delivered by a multidisciplinary team using a suite of strategies and interventions and operate within the governance structure of a healthcare facility. All healthcare workers are antimicrobial stewards and successful implementation of AMS programmes require collaboration between all members of the healthcare team, managers and service users. For more detail on the principles of AMS and the role each member of the healthcare team plays in AMS refer to the HSE antimicrobial stewardship (AMS) guidance for all healthcare settings (2022). This guidance is located on the AMS page on www.antibioticprescribing.ie .

For individual service users with suspected or confirmed CPE infection, consult a guide to treatment of CPE located on www.antibioticprescribing.ie . This specific guidance is a stand-alone guidance.

A comprehensive AMS programme addressing all antimicrobial use is important for the prevention and control of CPE in all healthcare settings.

Antimicrobial Stewardship in the context of an outbreak

The following AMS actions should be taken in the context of an outbreak:

1. Review the latest antimicrobial consumption data for the facility and provide feedback to prescribers. In particular, focus on consumption of classes that are most strongly- associated with selection of CPE:
2. In the acute hospital setting this includes: carbapenems, fluoroquinolones, third generation cephalosporins, anti-pseudomonal penicillins
3. In a community facility this includes “red” (non-preferred) antibiotics: co-amoxiclav, cephalosporins (other than cefalexin), quinolones and macrolides.

4. Based on the results of the antimicrobial consumption data review, and the resources of the facility, some classes of antibiotics may need to be restricted, reserved for clinical microbiologist (CM) or ID physician (ID) recommendation only, removed from ward stock, or be dispensed on a “named patient” basis from the pharmacy.
5. For hospitals consult the HSE policy on restricted agents available on the hospital-related page of www.antibioticprescribing.ie
6. The instigation of these special measures should be communicated to the facility’s prescribers, nurses and pharmacists, by the AMS programme lead, which is generally CM/ID or by the clinical director for the facility
7. The impact of these special measures should be reviewed periodically.
8. A pharmacist, this should be an antimicrobial pharmacist if available, should be a member of the outbreak control team (OCT) and report on, where relevant, for the particular setting:
9. Patients prescribed broad spectrum agents as listed above
10. Patients prescribed restricted agents without documented approval from infection specialist (CM/ID)
11. Antimicrobial prescriptions non-compliant with empiric local guidelines or www.antibioticprescribing.ie
12. Evidence of regular antimicrobial prescription review for suitability for de-escalation, IV to oral switch or discontinuation of antimicrobials, for hospital settings this is as per the ‘Start Smart & Then Focus’ Antibiotic Care Bundle.
13. Patients who are on antimicrobials for more than 7 days.
14. Depending on the severity of the outbreak there may be a need to allocate additional resources to implement antimicrobial stewardship.
15. Assess for evidence of a decline in the inappropriate consumption of restricted antimicrobials.
16. Patients with CPE who require antimicrobial therapy for suspected or confirmed CPE infection must be discussed with an infection specialist (CM/ ID) in accordance with national guidance. See “A guide to treatment of infection with carbapenem resistant organisms” located on www.antibioticprescribing.ie

17. Capture data on patients who are being treated for suspected infection due to CPE. This data should be provided by CM, ID and pharmacists for inclusion in the outbreak report and this should be provided to the OCT.

18. Data on patients who are commenced on treatment for suspected CPE infection could be a standing agenda item at OCT meetings.
19. Within the facility/unit/ward review ways to reduce unnecessary antimicrobial use:
20. Consider if infections may be self-limiting and not require the use of an antimicrobial, for example most ear infections do not require an antibiotic.
21. Use source control to manage the infections, for example, drainage of pus, removal of infected device, use of wound care.
22. Support the appropriate use of dipstick urinalysis in accordance with AMRIC position statements on their use to help prevent misdiagnosis of a urinary tract infection and unnecessary antimicrobial use.
23. Do not prescribe antimicrobials solely based on a culture result on a microbiological sample. Consider if there is evidence of infection or if the result reflects colonisation or contamination.
24. Review antimicrobial prophylaxis at regular intervals and consider stopping to prevent unnecessary use generating antimicrobial resistance and causing adverse effects for the service user, for example, nitrofurantoin, trimethoprim, azithromycin. Guidance available on www.antibioticprescribing.ie to inform reviews.
25. Minimise the duration of antimicrobial courses. The evidence base for the appropriate durations of antimicrobial courses for various infections is continually evolving. Consult www.antibioticprescribing.ie or local hospital guidelines for the most-up-date recommended duration for a particular infection. For example for most respiratory related infections in the community if antibiotics are warranted for sinusitis, pharyngitis/sore throat, acute bronchitis/cough, infective exacerbation of COPD and community acquired pneumonia in adults & children, the recommended duration of therapy is 5 days.
26. Prevent infection with vaccination
27. Promptly remove invasive devices, for example, intravascular devices, indwelling urinary catheters.
28. Use of IPC standard precautions at all times and transmission based precautions as appropriate, to limit the spread of infection or microorganisms.
29. In the context of an outbreak review the section on antimicrobial stewardship as there are many associated actions.

NOTE:
All prescribers should be communicated with by the Consultant Microbiologist and Lead Clinical Director on classes of antimicrobials that are restricted and reserved for use only on approval by Clinical Microbiologist or Infectious Diseases (ID) Physician. Refer to the latest version of the 'HSE national policy on restricted antimicrobial agents'
https://www.hse.ie/eng/about/who/qid/nationalsafetyprogrammes/hcaiamr/hse-policy-on-restricted-antimicrobials-july-2016.pdf

The Environment

In all healthcare settings, clinical areas used to accommodate patients, including areas for isolation or cohorting, should undergo periodic formal audit of the environment, including of the toilet facilities, by the Infection Prevention and Control Team (IPCT), with regard to the number of toilets and the general standard of available facilities including compliance with current Health Building Notes. For guidance on sanitary ware for healthcare, see Infection Control Guiding Principles for Buildings Acute Hospitals and Community Settings (2022)

https://www.hpsc.ie/az/respiratory/coronavirus/novelcoronavirus/guidance/infectionpreventionandcontrolguidance/residentialcarefacilities/Infection%20Control%20Guiding%20Principles%20for%20Building.pdf

One toilet per four patients is the minimum acceptable number.

Within healthcare facilities, if toilet facilities are lacking, the provision of additional toilet facilities should be addressed as a matter of urgency

Acute Hospital settings

The role of the hospital environment and equipment as a reservoir or as vectors for CPE

Experience in Ireland and internationally has resulted in increased focus on the hospital environment as a persistent reservoir for CPE and other multi-drug resistant Gram-negative bacteria (Enterobacterales and others). There is persuasive evidence that in a number of hospitals this may be an important source of CPE acquisition for patients.

CPE and other MDR Enterobacterales may be detected in some patient contact surfaces, in particular at or near drainage points from sinks, shower trays and sluices, if appropriately sensitive sampling and culture methods are used, refer to the section above on laboratory testing. Detection

of CPE on contact surfaces in these settings may reflect inadequate cleaning and decontamination after patient use. There is increasing concern that contamination of patient contact surfaces in the hospital environment may reflect retrograde contamination of contact surfaces with CPE organisms resident in the drainage system below the drainage point and can be a problem even with thorough cleaning. CPE from the drainage system is more likely to gain access to the patient contact surfaces where there the design and maintenance of fixtures and fittings are not optimal and where drainage is slow or incomplete. However, even when there are no readily identifiable problems with fittings and drainage there is evidence that retrograde contamination can occur (Kizny- Gordon 2015, Mathers 2019).

Note: transmission of CPE in acute hospitals by other routes has also been reported including contamination of food from kitchen sinks in hospitals (Pletzl 2018). Some reports have highlighted a role for endoscopes in the transmission of CPE in acute hospitals. (Marsh 2015, Maseda 2017, Kola 2015).

There is increasing evidence that in-patient room sink drains are an under-recognised reservoir for pathogens in the chain of hospital-acquired infection. There is significant evidence of cross transmission from sinks, multiple outbreaks reported caused by different bacteria and deaths reported associated with these outbreaks. Published epidemiologic investigations have linked sink drains to transmission of multidrug-resistant organisms & susceptible organisms.

Water can mobilise, transport, and disperse organisms over large distances (Weinbren 2020). Drainage systems link several connected devices including basins, showers, toilets, and therefore provide ideal mechanisms for organisms to spread across a hospital site, demonstrating the complexity in successfully addressing this patient safety risk. Cross transmission occurs from sinks connected to the water network, including kitchen sinks, showers, waste water pipework, regardless of single room separation. Sinks have complex associated pipework, difficult to eradicate biofilms and persistent contamination remains for prolonged periods acting as an environmental reservoir (Breathnach *et al* 2012, Weinbren 2020).

Environmental contamination which occurs from splashing into surrounding areas from a sink is an important consideration. Inpatient areas are frequently cluttered and it is therefore difficult to achieve a recommended distance from sink to bed and equipment VanderElzen *et al* 2019, Valentin *et al* 2021, Smismans *et al* 2019).

It has been demonstrated that a plumbing system can remain persistently contaminated, even after intensive decontamination efforts and repeated sink-trap replacement.

Behaviours in the context of environmental contamination

It has been reported that 96/100 activities at clinical hand wash basin were not related to hand hygiene. Poor practices have been identified in several research studies including use of hand wash basins for disposal of fluid/medication (including TPN, dialysis fluid, IV fluids, antimicrobials), waste disposal including urine, disposal of patients' wash fluids, disposal of drinks, coffee, juice etc. All of these factors provide an optimum nutrient rich environment and can therefore lead to proliferation of bacteria and MDROs in the sink (Shaw *et al* 2018, Weinbren *et al* (2021).

Environmental hygiene and monitoring in acute hospital settings (in the context of endemic/outbreak CPE)

Given the experience that drainage systems and associated plumbing fixtures and fittings (sinks, showers, and sluices) may serve as persistent reservoirs for CPE and other multi-drug resistant Gram-negative bacteria, outlined above, the following recommendations apply:

1. Acute hospitals have a complete and readily accessible inventory of drainage points and plumbing fixtures and fittings in clinical areas and food preparation areas. Any plumbing fixture and fittings that do not conform to current UK Health Building Note 001 Part C should be prioritised for replacement. Substandard fittings should be taken out of use, removed or replaced.
2. It is recommended that acute hospitals have a process in place for periodic documented checking of all water drainage sites. This is to ensure that water drains freely and completely from all plumbing drainage points. This should occur as part of normal cleaning practices. An escalation process should be in place in clinical areas to ensure that any staff member or service user can report this to the person in charge. A log of slow draining sites should be maintained to capture trends and possible linkages to cross transmission and outbreaks. It is recommended that drainage points with poor drainage or evidence of backflow should be taken out of use until repaired, where possible. A risk assessment should be conducted and escalated if this is not possible to achieve.
3. Acute hospitals should have a system in place to alert patients and staff to the risks associated with poorly draining plumbing fixtures. Patients and staff should be encouraged to report evidence of drainage problems or backflow and the relevant unit should be taken out of use until the problem has been resolved. (Taking a sink or shower

out of use need not require restriction on admission to the associated bed spaces provided alternative arrangements to maintain hand hygiene, clinical services and patient's personal hygiene and bathing solutions are in place.)

4. Acute hospitals should have processes in place to monitor and assure the effectiveness of cleaning programmes in clinical areas. In the context of CPE there is a need for a particular focus on hand hygiene sinks, toilets, sluices, bathing facilities and sinks used in food preparation areas.

   Where there are challenges to action the above recommendations due to competing factors, a risk assessment and escalation processes should be in place.

5. Processes to monitor include the use of fluorescent markers or ATPase are included in in order to assure the performance of cleaning in some countries and may merit consideration in relevant clinical settings.

6. Acute hospitals should monitor for environmental contamination with CPE where there is evidence of sustained CPE acquisition in the hospital, suspected linkages between the environment and acquisition and outbreak activity. Collection and processing of samples should be in accordance with the methods outlined in "Guidance relating to laboratory testing for CPE and Interpretation and Clinical Application of Results. Version 1.0 2019. Sampling should generally focus on sinks, shower trays and sluice/disposal areas or areas which the Infection prevention and control team deem relevant in the context of acquisition.

SECTION 2

Outbreak/Endemic CPE

Managing Endemic CPE/ CPE Outbreak in the Acute Hospital Setting

What is the definition of a CPE outbreak?

The World Health Organization states that a disease outbreak is "the occurrence of cases of a disease in excess of what would normally be expected in a defined community, geographical area or season"

Acute Hospital setting

It is recommended, in relation to CPE in an acute hospital, that an outbreak be declared if there are two or more linked cases of CPE or an increase in the incidence of CPE above the background rate for that institution.

Note that in the context of a hospital with endemic CPE two or more linked cases is understood to mean cases with a non-endemic type of CPE or two or more cases with the endemic type of CPE occurring in a narrow time frame and with persuasive evidence of a link in space and time. This requires clinical judgment which may be supported by liaison with the CPE reference laboratory service regarding molecular characterisation of the isolates from patients and relevant environmental isolates.

Infection prevention and control activities, particularly in the context of an outbreak are usually multi-faceted or delivered as a bundle. This makes it difficult to determine which components of a response are most important. As in many other areas of healthcare, practice may be based, of necessity, on consensus and expert opinion; because formal research studies to evaluate the evidence as to the relative importance of individual components of a bundle of interventions is often not available.

Challenges of early identification of an outbreak

CPE outbreaks can be difficult to recognise early. There are a number of challenges in identifying potential CPE transmission in an acute hospital for a number of reasons:

Screening

CPE are mostly carried asymptomatically in the bowel. Because of this it may not be known that a person is carrying CPE unless a rectal swab or faeces specimen is taken to screen or check for CPE. If robust screening protocols are not implemented in an acute hospital, this increases the risk that CPE carriers will not be detected and that CPE may therefore be more likely to spread and evidence of transmission more difficult to detect.

Patient movement

Patients move between several wards and departments when they are admitted to a hospital for many reasons. They may spend varying amounts of time in each place including the emergency department (ED) to different wards and from the ward to other departments such as the operating theatre, radiology, endoscopy etc. The epidemiological links, therefore, between CPE cases may be difficult to identify even with careful review of patient journeys.

Hospital length of stay

The length of stay in hospital is an important factor to consider, as inpatient stays are generally getting shorter. Some patients may have been discharged before a potential contact with a CPE case or link to a CPE outbreak is identified.

Undetected CPE

Transmission of CPE from patients with undetected CPE colonisation or from contamination of the patient environment may explain cases of CPE in settings where the source of CPE is not apparent.

Identification of the Index case

The first CPE case identified may not be the index case detected within the clinical setting. The examination of the patient's journey prior to CPE detection, may not identify all potential contacts and therefore other cases might be missed.

Different microorganisms with the same type of carbapenemase

A highly transmissible plasmid is often involved, for example, a plasmid carrying OXA-48, which is readily exchanged between different Enterobacterales. This means that two patients with different species of Enterobacterales producing the same type of carbapenemase (for example, one OXA-48 producing E. coli and one OXA-48 producing Klebsiella pneumoniae) and with different antimicrobial susceptibility patterns might indicate a CPE outbreak.

Robust laboratory testing protocols

A robust microbiology laboratory testing protocol is essential in acute hospital settings to ensure that CPE can be picked up from screening and clinical specimens and reported rapidly to the infection prevention and control team and confirmed as quickly as possible (either local confirmation or confirmation by the national reference laboratory service). Timely confirmation of a suspected CPE case is important, because the carbapenemase type, such as IMP, KPC, OXA-48, NDM or VIM, may be the key to identifying a potential link between CPE cases.

Local surveillance systems

A robust local surveillance system is vital to ensure that all new suspected and confirmed CPE cases are carefully reviewed by the Infection Prevention and Control Team (IPCT) in a timely manner. This allows the team to determine quickly any potential association with the hospital or particular unit. This process is vital to early identification of potential increased CPE incidence, which may warrant further investigation.

Comparison of isolates

Patients in whom CPE is detected by validated direct molecular methods should be considered in the same way for infection prevention and control purposes as patients from whom CPE has been detected by conventional culture. Laboratories should attempt to culture the organism from such patients to facilitate comparison of isolates.

Association of a newly-detected CPE patient with the acute hospital

The challenges as outlined previously are also challenges to identifying potential association between a newly detected patient with CPE and a particular hospital.

Difficulty in determining the first patient

Occasionally, a microbiology specimen taken from a patient in the context of investigating suspected infection (for example, urine, wound swab or blood culture) might be the first specimen found to contain CPE. If there are no previous microbiology specimens from that patient during the hospital stay, it may be difficult to determine exactly where the patient acquired the CPE.

Low levels of CPE

A patient could be admitted to hospital carrying CPE at very low levels, which might be below the threshold of detection of the CPE screening test in use and therefore be reported as “CPE not detected” on admission screen. Subsequent antimicrobial exposure confers a survival advantage

for CPE, enabling them to multiply and become more readily detectable on a subsequent CPE screen. Thus a patient may appear to have acquired CPE recently whereas in fact they have carried CPE for some time but it has only recently become apparent.

Time lag before CPE becomes detectable

It may be very difficult to determine when a person picked up CPE, because it can take several weeks after contact before CPE becomes detectable from a screening specimen.

No antimicrobial susceptibility testing performed

A diagnostic specimen with mixed growth (and including Enterobacterales) may not have antimicrobial susceptibility testing performed in the absence of relevant clinical information to support infection. If CPE is detected from a screening or diagnostic specimen taken from the same patient at a later date during the same admission, it may be impossible to determine if one of the bacteria in the earlier sample was CPE.

CPE contacts

A patient who is identified as a CPE contact of a newly-confirmed CPE case may be screened for the first time as a CPE contact. In the event that the CPE contact is subsequently confirmed to also be a CPE case, a careful review is recommended. The possibility that the CPE contact was actually the source of transmission for the index CPE case needs to be considered.

The quality of the sample

The quality of the diagnostic or CPE screening specimen will influence the likelihood of recovery of CPE from that specimen and in turn the validity of the test results. If an initial sample is not of good quality, a subsequent correctly-taken specimen that tests positive for CPE may appear to be a newly acquired CPE associated with the specific hospital.

Action in the event that a CPE outbreak is suspected or confirmed

1. Convene and incident management group/outbreak control team if a CPE outbreak is suspected.
2. Outbreaks of infectious diseases **MUST** be notified to the regional Department of Public Health under Irish Infectious Diseases Regulations. The hospital should follow the HSE Guidance for notification of an outbreak. (Notification of Infectious Disease Outbreaks to Departments of Public Health in acute hospital settings, declaration of an outbreak and closure of an outbreak): https://www.hse.ie/eng/about/who/healthwellbeing/ourpriority-programmes/hcai/resources/general/noid-declaration-and-closure-of-anoutbreak-acutes.pdf.

The Department of Public Health should be invited to attend OCT meetings and included on circulation of minutes.

3. In addition to notifying the Department of Public Health of the CPE outbreak, the hospital should also inform the HSE-AMRIC team.
4. The OCT should carry out an assessment of the situation to determine if there is an outbreak and guide the management of situation.

Determining the Factors Contributing to CPE Spread in an Outbreak.

Key steps in controlling a CPE Outbreak are recognising the outbreak early and assessing and addressing the factors most likely to be contributing to the outbreak. Direct and indirect person to person spread are generally accepted as important factors in CPE outbreaks. While managing the risk of direct and indirect spread remains important there is evidence, that persistent environmental reservoirs (in particular drainage points in plumbing fixtures) may be important in many outbreaks leading to ongoing transmission.

The Checklist provided below will support Hospital Management and OCTs to ensure that key issues are considered and addressed.

Endemic CPE in Acute Hospital settings

A number hospitals within Ireland that declared outbreaks since the first reported case in 2009, continue to experience a persistent, often low level, of CPE acquisition associated with inpatients in the hospital. Many hospitals continue to have persistent environmental reservoirs of CPE in the hospital settings. While there is a need for continuing focus on measures to manage the risk of CPE acquisition, in many cases this is now better characterised as an endemic problem that needs ongoing management rather than as an outbreak.

CPE acquisition in an acute hospital may be considered to have transitioned to an endemic state when the following criteria are met:

1. The outbreak was declared more than 12 months previously
2. The hospital is implementing the national guidance on testing of admissions for CPE
3. The incidence of CPE acquisition is less than 1 person newly acquiring CPE per 10,000 bed days used
4. The incidence of CPE acquisition has been essentially stable for 6 months or more in the context of implementation of all practical measures to interrupt transmission

Action in the event that CPE has become endemic in your hospital

When it is recognised that CPE acquisition in the hospital meets the criteria for being described as endemic, in consultation with the IPC team and Public Health the outbreak may be declared over.

The ongoing management of the risk of CPE acquisition should transition to the IPC risk management processes that apply within the hospital to other AMR bacteria and healthcare associated infections.

What are key considerations for managing endemic CPE?

For these purposes each type of CPE (for example OXA-48, OXA-181, KPC-2, KPC-3, NDM) should be considered separately but different species of Enterobacterales carrying the same type of CPE do not need to be considered separately.

Note that after a hospital transitions to endemic status, in the event that the hospital identifies an atypical cluster or pattern of cases of acquisition of CPE, emergence of a new type of CPE, or an incidence of acquisition that represents significant variation from baseline it is appropriate to declare a new outbreak.

Challenges in implementing CPE recommendations

It is recognised that implementation of these CPE recommendations will be difficult for all hospitals; this is likely to be particularly the case during winter periods, with managing other Infection Control risks, for example COVID-19, and with the increased demands due to increased hospital presentations and managing other respiratory illnesses . Supporting adequate ward staffing required for full compliance with demanding infection prevention and control clinical practice and for environmental cleaning and facilities maintenance can be challenging in relation to availability of staff and funding. The guide to balancing competing demands in relation to restrictions on bed use related to infection prevention and control can be used as a support decision making in relation to balancing risks, in particular due to challenges when IPC recommendations require significant closure of general access to beds with impacts on sustaining clinical service. https://www.hse.ie/eng/about/who/healthwellbeing/our-priority-programmes/hcai/resources/general/guidance-on-balancing-competing-demands-in-relation-to-bed-use.pdf

Where there is concern that other clinical concerns may take priority over adhering to IPC requirements

Many hospitals have limited facilities for optimal patient placement (single patient en-suite rooms) and have significant demand on available rooms for other IPC requirements and other reasons. The link below to this HSE document supports decision making when prioritising use of single rooms:

https://www.hse.ie/eng/about/who/healthwellbeing/our-priorityprogrammes/hcai/resources/general/priority-guide-for-isolation.pdf

Specifically, in relation to CPE, where access to isolation rooms or suitable cohort facilities is not adequate, the following approach to prioritisation is recommended in order of descending priority:

1. Patient with confirmed CPE with diarrhoea, incontinence of faeces, stoma bags, urinary catheters or behavioural disturbance that may increase likelihood of spread of faeces
2. Patient with confirmed metallo-beta-lactamase-type CPE (NDM, VIM)
3. Patient with confirmed CPE of non-metallo-beta-lactamase type (IMP, KPC, and OXA-48)
4. CPE Contacts. There is reason to consider that contacts with one or more recent samples reported as "CPE not detected" may represent a lower risk for spread of CPE compared to contacts that have not been tested. Consideration must be given in the context of outbreak activity, infrastructure and cross transmission risk.

In situations where these recommendations are not fully implemented, control of onward CPE transmission is likely to be less effective, may take longer to achieve with prolonged CPE activity and impacts on patients and service users.

IMPORTANT

The management of CPE risk cannot be allowed to cause significant delay in patient access to areas such as rehabilitation, operating theatres, radiology and other areas/departments for essential investigations/interventions.

Outbreak Control

Acute Hospital setting

A CPE outbreak checklist is aimed to support the control of a CPE outbreak in an acute hospital setting. This checklist is not intended to be exhaustive, and it is not intended to imply that every facet of the checklist is relevant to every outbreak situation. The hospital Outbreak Control Team (OCT) will advise on the measures within the checklist that require implementation. This will be determined by the OCT taking account of the specific context, extent of the outbreak, local resources, isolation capacity etc.

The hospital OCT and IPC team will decide the priority associated with the features on the checklist and may decide that some measures recommended are not applicable or relevant or that additional control measures are required, depending on the particular circumstance. Those tasked with the measures will also be determined locally, except where clearly specified.

Note that as with all IPC practice, due regard must be given to adapting practice to the specific needs of individual patients, for example those approaching end of life.

Informing Key Stakeholders and Notification

1. Ensure that upon identification, the outbreak has been promptly communicated through the hospital internal management and risk management structures and that all relevant staff and affected patients are informed.
2. The outbreak must be formally notified to the Department of Public Health, at this time, in keeping with the Infectious Diseases Regulations. Use the HSE Procedure and form for documenting the opening of an outbreak Notification of Infectious Disease Outbreaks to Departments of Public Health in acute hospital settings, declaration of an outbreak and closure of an outbreak.
3. Inform one of the Consultants of the Antimicrobial Resistance and Infection Control Team, at: AMRICClinicalLead@hse.ie
4. If support in outbreak management from the AMRIC Team is required the Consultant Microbiologist, Department of Public Health or GM/CEO should contact the HSE AMRIC Clinical Lead to request support.

Surveillance

1. Convene a multi-disciplinary outbreak control team (OCT), which should be chaired by the most senior manager Chief Executive Officer (CEO) or General Manager (GM) as per hospital governance structure, and include active participation by the Clinical Director (CD), representative clinicians and director of nursing. A representative of the local Department of Public Health should be invited to attend the OCT and receive copies of OCT meeting minutes.
2. The frequency of OCT meetings should reflect the epidemiology, the number of wards or services affected and the impact of the outbreak on activity.
3. Latest surveillance and microbiology laboratory updates should be available at OCT meetings.
4. The OCT agenda should include a review of the latest available epidemiological data on new cases and the wards with which the new cases are linked. The latest prevalence and location of CPE cases by affected ward should also be noted. In a larger outbreak, the potentially large number of patient movements and contacts may necessitate regular and separate reviews of outbreak epidemiology conducted by the IPCT outside of the OCT meeting, with the findings presented at the OCT meeting.
5. Timely and latest available surveillance data should be shared through local governance structures with staff working on affected ward/s, so that they can see how they are doing (for example, a weekly run chart of new ward-acquired cases, weekly point prevalence of known CPE patients cared for on the ward, and compliance with ward CPE screening policy).
6. Rapid on-site confirmation regarding CPE isolates and the type of CPE should be performed. Both rapid molecular and lateral flow (immunochromatographic) systems are available. If for any reason rapid local confirmation is not possible, suspect isolates should be referred immediately to the National CPE Reference Laboratory (NCPERL) for confirmation with an indication that urgent processing is requested.
7. The need for and practicality of performing a formal epidemiological evaluation such as a case control study should be considered by the OCT in the setting of a larger or complex outbreak. Capacity to perform a case control study with the OCT and the Department of Public Health may be a limiting factor.

Screening recommendations and patient placement (in the context of an outbreak)

1. Closure of an outbreak ward to new admissions should be considered. Closure is generally appropriate, at least initially, if there is evidence of extensive or very rapid transmission on a specific ward. After the risk has been assessed and control measures implemented it is appropriate to review the need for ward closure at each OCT meeting. It is also advisable to set out and agree early, what the criteria would be for re-opening the ward to admissions. If, for any reason the hospital management form a view that the advice of the Infection Prevention and Control Team on ward closure or other restrictions on bed use cannot be implemented, the hospital should follow HSE "Guidance on Balancing Competing Demands in Relation to Restrictions on Bed Use Related to Infection Prevention and Control." A risk assessment should be undertaken, escalated within local governance structures and documented on hospital risk register.
2. Patients who are colonised with CPE and patients who are CPE contacts should be accommodated as outlined earlier in this document.
3. Check that outbreak control measures are adapted to and have regard for the needs of individual patients in particular those with specific needs or those approaching end of life.
4. Where possible, there should be dedicated equipment for use on affected patients. If this is not possible, a robust system to ensure adequate cleaning and decontamination between patients is required and must include a system for documenting that the required cleaning and decontamination has taken place. . This should be monitored and documented.
5. Review and check compliance with local CPE screening policy and identify any gaps with regard to the recommended CPE screening guidelines as outlined above. Consider if a level of screening beyond that specified in national guidance is required in the context of the outbreak control measures.
6. Identify contacts of confirmed CPE cases in accordance with current guidance. Check that CPE contacts are informed, that they are CPE contacts as previously outlined, and that inpatient CPE contacts are promptly offered screening for CPE.
7. As above people discharged home before a CPE case is identified should not generally be designated as CPE contacts but exceptions may be appropriate in an outbreak setting based on the OCT risk assessment. If people are designated ad CPE contact in their chart or on the hospital patient administration system /infection control surveillance system,

after they have been discharged home, they should be informed, in line with local arrangements that they are CPE contacts, and a local process is required to identify them at a specific increased risk of CPE colonisation if they represent to the hospital.

8. When people designated as CPE contacts have completed the recommended protocol for testing for colonisation and have been assessed as no longer requiring designation as CPE contacts, the paper or electronic alert should be discontinued, following local processes. This should be clearly documented.
9. Ensure the microbiology laboratory has the required resources (for example, staffing and laboratory consumables) needed to deliver both the routine CPE screening programme, and to support the additional recommended screening requirements for outbreak investigation and control.
10. Check that laboratory capacity is adequate to provide the support required and that it has the capacity to provide environmental monitoring for CPE as appropriate in the context of an outbreak.

Patient movement

1. Patient movements off the ward for non-clinical reasons (hospital shop, chapel visits) should balance risk of transmission with the impact on patient morale of limitation of movement. The risk associated with mobile continent patients leaving the ward to go to the hospital shop or chapel or to go for a walk outside is very low if they perform hand hygiene before leaving the ward and refrain from using toilets in public areas.
2. Patients should be asked to check with staff before leaving the ward. If patients wish to leave the ward staff should advise and facilitate the patient to perform hand hygiene before leaving the ward, they should avoid direct contact with other patients and they should be advised not to use public toilets when off the ward.
3. It is recommended that transfer of patients with CPE between wards should be avoided, unless based on clinical need (for example, escalation or de-escalation of care) or to facilitate single room placement or cohorting. Transfer requires advance and clearly documented communication with the receiving ward nurse manager. Where patients are moved, a process should be in place to ensure that tracking and traceability can take place, should further contact tracing be required due to new case detections in that area.
4. Transfer of patients between departments (for example, to operating theatre, or

radiology) requires advance and clearly documented communication with the nurse manager of the receiving department, who in turn must ensure adequate IPC precautions and an up-to-date local policy are followed to minimise the risk of transmission. There should not be undue delays in patient access to investigations or interventions attributable to their CPE status.

5. Transfer of patients between services (for example, between acute hospitals, from acute hospital to primary care or from acute hospital to residential care) requires advance and clearly documented communication with patient transport services and the receiving service. The receiving service must take all practical measures to minimise the risk of transmission.
6. There should not be undue delays in patient transfer and patients or residents should not be denied care in any facility because of their CPE status. Please also refer to the section above on inter-facility transfer of patients colonised or infected with antimicrobial resistant organisms (AMRO), including CPE.

Staff education on hand hygiene, precautions, and PPE

1. It is important to focus staff on the importance of basic infection control measures which should be applied at all time for all patients are the mainstay in preventing cross transmission, see previous link to AMRIC HSELand modules. Systems should be in place to assess if all staff training records are up to date including induction and periodic retraining on standard and transmission based precautions.
2. In the setting of an outbreak, additional refresher training on standard precautions and transmission based precautions should be provided to relevant clinical areas with outbreak activity for **all** clinical staff. IPC Teams will normally be responsible for delivery of training and line managers for ensuring that staff, in particular nursing and medical staff attend training provided. Online AMRIC IPC training resources are available on HSELand to support training requirements. Hand hygiene training may be provided through an established train the trainer programme.
3. Additional audits of staff compliance with standard (in particular, hand hygiene technique and opportunities taken) and transmission-based precautions may be required on all wards.

4. Wards affected by an outbreak should be supported to provide real-time feedback on non-compliance with hand hygiene and other elements of standard precautions and transmission based precautions to staff and others involved in direct or indirect patient contact.
5. Ensure there are sufficient stocks of personal protective equipment (PPE) and it is readily available at point of use to meet additional demands, along with increased frequency of waste collection and disposal. A point of care risk assessment (PCRA) should be conducted in relation to selection of appropriate PPE.
6. Provide sufficient IPCN resources to deliver staff CPE education and audit of Standard Precautions and Transmission Based Precautions.
7. Assess hand hygiene facilities. Hand hygiene sinks should be used for hand hygiene only and not for disposal of fluids or other purposes, see above section on behaviours and environmental factors.
8. Provide training on cleaning and disinfection for staff and ensure that they are aware of the importance of their role in outbreak control. Review the environmental audit scores to determine if improvements can be made to support control measures.

Communication in the context of an outbreak

Communication with staff

1. Ensure that all staff members have been formally notified by senior management structures that there is an ongoing outbreak. The line manager of every staff member, including contract staff must communicate what is required. Communication should use the most effective means to ensure all staff members are aware, for example email, internal communications processes, newsletter, letter, text message, staff App. The frequency is best determined locally and will depend on the extent of the outbreak, amongst other things.
2. A series of meetings can be held and chaired by hospital senior management for all staff may be appropriate (as required) and should provide key facts on the outbreak organism and address common staff and patient queries. Attendance should be recorded.
3. All staff including ward managers, nurses, medical staff, allied health professionals, healthcare assistants, porters, clerical, cleaning, maintenance and catering staff working on affected wards need to be supported to take ownership

of the outbreak control measures and must understand their individual and critical roles in the successful control of the outbreak, in partnership with the OCT.

4. The hospital should have a designated easy-to-find repository of all documents associated with CPE and the outbreak response, which is easily accessible by all hospital staff.
5. The Occupational Health Department should be resourced to address potential staff fears or to address queries in conjunction with the OCT. In particular staff should be aware that screening of staff for CPE is very rarely appropriate.
6. Ensure all signage complies with the agreed measures for CPE cases, CPE contacts and patients with other transmissible organisms. It should also be up- to-date, clear and placed where it is visible to staff entering an outbreak areas/isolation room or cohort area, so they know what precautions are required, ensure ongoing staff communication at local and ward level for visiting staff to these areas. Periodic checks should be performed to ensure that these remain in place at the appropriate locations, and are removed when no longer required.
7. Update signage at entrance to wards affected by the outbreak, so that it is evident there is an outbreak on the ward.
8. Ensure swipe card access is activated on doors linking wards, with signage telling staff and visitors not to take shortcuts between affected and unaffected wards.

Communication with patients, visitors and the public in the context of an outbreak

1. Ensure that patients who are colonised with CPE and those identified as CPE contacts are promptly informed in accordance with national guidance, as outlined above. The hospital should have a clearly defined pathway and accountability for patient communication and it should be documented in the clinical notes that the patient has been informed. As with other clinical information, the primary clinical team responsible for care of the patient is responsible for informing the patient.
2. Provide with a durable wallet/ purse-sized card indicating that they have had a positive test for CPE and advised to use the card to alert healthcare providers to their CPE status when they present for future care. Patients should be provided with a patient information leaflet or frequently-asked question (FAQ) document or card (see section on Communication for more detail).

3. Use an electronic IPC software and electronic flag system on the patient administration to identify the patient as colonised or infected if the facility to do this is available. Have local processes in place to manage these.
4. Check healthcare records of patients confirmed CPE positive for evidence of documentation that the patient has been told of their status and conduct regular audits to monitor this. Feedback should be provided through local governance structures.
5. To facilitate the process, consider the use of the pro-forma alert sticker for the patient's chart which may include space for the clinical team to sign/ confirm that the patient has been told about their status (See Appendix 4 for a sample template for an alert sticker).
6. Ensure there is an adequate stock of relevant patient information leaflets on all wards and in areas where public and patient information is provided. These should be freely available, refer to earlier communication section for ordering details.
7. Ensure that patients receive information on the importance of hand hygiene (after using the toilet, bedpan or commode and before eating) and additional hand hygiene opportunities, as deemed appropriate to their clinical situation. Ensure that patients who require support to perform hand hygiene (for example those who cannot independently access hand hygiene facilities) are appropriately supported and hand wipes are made available for this group of patients.
8. Ensure that visitors are informed of the importance of hand hygiene and have access to alcohol-based hand rub dispensers. Consider the provision of hand-sanitising wipes to patients, families and visitors on affected clinical areas, to support good hand hygiene practice.
9. Prepare a short written message to be given to every patient by the clinical staff on their ward telling the patient that there is an outbreak ongoing and the actions the hospital is taking to keep them safe, and prevent them acquiring infection. Use the text available in information leaflets at www.hse.ie/infectioncontrol to guide development of local letters or leaflets.
10. The hospital communications department should be pro-active in ensuring open and transparent communication, in accordance to open disclosure national guidance with patients, families and the community they serve, refer to section on communication for more information. Engagement with local communications teams, including information via print, broadcast and social medial may be appropriate to disseminate information.

Communication between healthcare facilities of a patient's CPE status

1. Refer to the previous section on interfacility transfer communication for greater detail. Communication should be on a need to know basis and consistent with the patient's right to dignity and privacy. Use an electronic IPC flag system to flag the patient's record if available.
2. Implement a formal healthcare record alert for all patients with CPE.
3. Regarding the healthcare record alert:
4. The inside of the front cover should have a written description of the alert, the date of the positive result and the date of the alert
5. In the event of a new healthcare record being created or the existing healthcare record being split, it is recommended the medical records department places a new sticker on the new healthcare record with the information from the previous version. Local processes should be in place to ensure that this is performed for each subsequent chart formation/transfer.
6. The pro-forma alert sticker can be filed chronologically in the patient's healthcare record on the date the alert was created.
7. If all confirmed CPE cases have not had a formal healthcare record alert created, retrospective placement of alerts should be performed when charts are used.
8. Check discharge letters to general practitioners (GPs) for evidence that the GP has been told about their patient's CPE status. Periodic audits should take place to ensure that this is completed.
9. Develop a pro-forma communication to be systematically sent to the admitting consultant or GP of every patient once confirmed as colonised or infected with CPE. This serves as a safety net if the patient has since been discharged, or it is not certain that the GP was told, or if an electronic discharge letter or copy of discharge letter does not exist for review. The communication should include or provide a link to patient information.
10. A local secure electronic database of all confirmed CPE cases would be helpful, including confirmation that an alert was placed on the healthcare record, an electronic IPC alert flag active, and confirmation of patient and GP communication status.
11. Where a newly-detected CPE case is identified and there is reason to believe that acquisition may be related to another healthcare facility the appropriate staff (IPC Team or relevant Nurse Manager) should be informed promptly. This information

should also be included when the case is notified to the Department of Public Health.

Environmental hygiene

During an Outbreak

1. Ensure that hygiene services (cleaning) staff members are represented on the OCT and are included in any ward-based briefings and educational interventions.
2. Environmental cleaning and disinfection should be carried out at least twice daily in the area impacted by the CPE outbreak. Cleaning 4 times per day between 6am and midnight is required for toilets and bathing facilities shared by CPE positive patients. This should apply to also to immediately adjacent toilets accessible to CPE positive patients even if those toilets are not specifically designated for their use.
3. Where cleaning resources are not adequate to meet the recommended cleaning frequencies, ensure that there is an escalation process in place and that a risk assessment is conducted. A review of cleaning resources used in non-clinical areas should be conducted in order to prioritise cleaning resources to where they are most needed.
4. There should be assurance that the technique of cleaning is correct and that the sequence of cleaning is correct particularly for sink cleaning, to ensure that taps do not get contaminated from drains. There should be supervision in place to ensure that cleaning is performed to the recommended standard. Refer to section on Environment for further details.
5. Use environmental microbiological sampling to assess for environmental reservoirs of CPE. Consider also using to verify efficacy of cleaning, based on OCT advice. This may not be necessary in very small or short-lived outbreaks. Sampling should be performed before and after cleaning.
6. In consultation with cleaning staff, consider the use of tools such as test soils prior to cleaning, ultraviolet (UV) light after cleaning or adenosine triphosphate (ATP) to evaluate efficacy of cleaning.
7. Equipment disinfection. Consider use of test soils prior to cleaning and UV light after cleaning or ATP to evaluate efficacy of cleaning.

a. The use of novel decontamination systems may be considered in certain circumstances.
b. Ensure multi-disciplinary hygiene audit teams are conducting audits on all areas

on an ongoing basis and that quality improvement action plans are in place and followed-up within specific timelines, where indicated by audit findings. Consider increasing the frequency of such audits for affected ward areas. Audit results should be reviewed and actioned through local governance structures.

8. Check the integrity of surfaces of all floors, walls and fixtures to ensure that there is no exposed plaster, bare wood or corrosion of surfaces or fittings that precludes effective cleaning. Any area which cannot effectively cleaned due to deficits or where there are infrastructural deficits outlined above should have this escalated through local governance structures and addressed as a priority. This should be risk assessed and placed on the local risk register.
9. Check the integrity of chair coverings and furniture under surfaces, remove and replace if damaged.
10. Check the integrity of mattresses and pillows: remove coverings to evaluate inside material, especially if seams are not sealed and remove and replace if poor integrity or damaged. A review of local audits should be conducted also to determine if this has been previously identified and actioned.
11. Check toilets to ensure they can be properly cleaned and that the fittings and fixtures are of cleanable quality and are functioning well.
12. Ensure that all drains in showers, baths and other facilities conform to the relevant Health Building Note and function so as to allow free downward flow of water and that there is no back flow or pooling of water. Fittings that do not meet the requirements should be taken out of use, removed or replaced. Slow draining showers, baths and sinks should be reported, investigated and actioned. Where this is not possible, due to infrastructural issues and bed pressures, a risk assessment should be conducted and placed on the local risk register. Alternative bathing solutions may be offered as an interim measure.
13. Environmental sampling for CPE targeting in particular drainage points from plumbing fittings (showers, sinks, sluices) should be generally be performed as part of the assessment of CPE outbreaks except where the number of cases involved is very low and the outbreak is of short duration.
14. Check sluices, bed pan washers (temperature controls, service records, test soils etc.), bed pans and commodes. Check and audit practices in relation to their correct use and ensure that staff have appropriate training. Ongoing period reviews/audits of these are required.
15. Ensure all ventilation service records and monitoring records within affected areas

are up-to-date and signed-off by technical services department staff.

Minimise clutter

1. Confirm that all PPE is easy to access at the point of use and is stored in a manner that minimises contamination of PPE, that it is wall-mounted outside the patient room and contains all of the required PPE safely avoiding cross contamination and minimises clutter.
2. Ensure that any unused or unnecessary equipment is removed from wards and that there is a process to monitor and track equipment movement.
3. Continuous review and ongoing decluttering is recommended. Refer to section on Environment with detail on removing equipment/consumable items from the wash hand basin zone in order to minimise cross transmission risk due to splashing.
4. Ensure that used equipment awaiting decontamination is stored in a designated area away from clean equipment to prevent cross contamination.
5. Dispose of old, damaged equipment and replace.

   Ensure there are sufficient chairs, so that people aren't sitting on patient beds where they are at risk of contaminating their clothing. Ensure that staff, visitors and patients are aware of this recommendation and discourage this practice when observed.

   Keep isolation room doors closed, unless patient need dictates otherwise. Document risk assessment regarding doors needing to stay open for other reasons, including patient safety. If a door cannot be closed, ensure that signage regarding the required transmission based precautions is in place so that it remains clearly visible to staff prior to room entry.

Minimise traffic

1. A decision should be made as to whether additional controls on visiting should be applied to support staff in controlling the outbreak. However, note that there is no reason to believe that visitors are important in sustaining spread of CPE in the hospital setting. Visitor traffic on wards can create additional challenges for staff, for example cleaning, in the very demanding context of responding to an outbreak. Additional restrictions on visiting should balance the risk that this will may impact on patient morale with the likely value in helping to control the outbreak.

2. Consider temporarily limiting or cessation of non-essential services on outbreak ward(s) (for example, mobile services: hairdresser, mobile shop, mobile library). Restriction on these services should balance the risk that this will may impact on patient morale with the likely value in helping to control the outbreak. These service providers should be supported to perform hand hygiene correctly, before and after contact, as per WHO 5 moments, as appropriate to their role.
3. Patients with CPE who have borrowed books from a hospital library should be allowed to keep the books. The books should not be returned to the library stock.
4. Pastoral care services to patients should be reviewed to ensure that they are provided in a manner that does not contribute to perpetuation of the outbreak. Provide necessary training and education to these staff on hand hygiene, standard and transmission based precautions, as appropriate to their role.
5. Consider discontinuation for a period any volunteer services that have direct patient contact or deliver patient care on affected wards. Ensure any volunteers in this category have received formal training on hand hygiene, standard and transmission based precautions prior to the re-introduction of services.
6. Visitors and volunteer services that visit patients but do not deliver personal care or have direct contact should be requested to visit one patient only per visit and not to move between patients during visiting times.
7. Restrict nursing, medical and allied health professional student activities on affected wards to supervised work placement, with confirmation that training on hand hygiene, Standard and Transmission Based Precautions has been undertaken prior to placement.
8. Clinical team ward rounds should end on CPE affected wards, but the individual patient's clinical needs should not be compromised when they require review. The number of team members entering the patient zone should be limited to those absolutely necessary and all staff entering the patient zone of an isolation room or cohort area must perform hand hygiene and don recommended PPE (in line with PCRA) prior to entry.

Antimicrobial stewardship acute hospital setting in the context of an outbreak

Refer to section on antimicrobial stewardship for detail.

Resources

1. Confirm the adequacy of resources available to manage the outbreak with particular focus on the provision of single rooms, numbers of nursing and healthcare assistants on affected ward(s), resources for cleaning, infection prevention and control, surveillance, pharmacy, equipment, IT and clerical support for the outbreak.
2. Confirm that there is sufficient consultant microbiologist/ ID, IPCN, pharmacist, microbiology laboratory scientist, and surveillance scientist resources to support the increased demand on the microbiology laboratory and antimicrobial stewardship, IPC and outbreak control. Take into account requirement for 24/7 access to clinical microbiologist advice, potential need for 7/7 on-site IPCN presence during an outbreak and whether or not daily OCT meetings over a weekend period dependent on size and extent of outbreak.

Outbreak Closure

1. If the outbreak is over refer to the above relevant section on outbreak/endemic status.
2. If transmission has not ceased but has declined to a very low level consider if criteria for changing status from CPE outbreak to endemic CPE, as outlined below.

   Use the template in the HSE policy "Notification of Infectious Disease Outbreaks to Departments of Public Health in acute hospital setting- declaration of an Outbreak and Closure of an Outbreak. https://www.hse.ie/eng/about/who/healthwellbeing/our-priorityprogrammes/hcai/resources/general/
3. The final outbreak summary report should be forwarded to the local Department of Public Health, to senior management in the hospital and hospital group in line with local governance structures and processes along with formal notification of the local Department of Public Health of closure of the outbreak.
4. An outbreak report should be completed to incorporate lessons learned and shared with local hospital management through appropriate governance structures.

Transition to endemic CPE management from outbreak management

CPE acquisition in an acute hospital may be considered to have transitioned to an endemic state when the following criteria are met:

1. The outbreak was declared more than 12 months previously
2. The hospital is implementing the national guidance on testing of admissions for CPE

3. The incidence of CPE acquisition is less than 1 person newly acquiring CPE per 10,000 bed days used
4. The incidence of CPE acquisition has been essentially stable for 6 months or more in the context of implementation of all practical measures to interrupt transmission

At that point, in consultation with the IPC team and Public Health the outbreak may be declared over and the ongoing management of the risk should transition to the IPC risk management processes that apply within the hospital to other AMR bacteria and healthcare associated infections.

For these purposes each type of CPE (for example OXA-48, OXA-181, KPC-2, KPC-3, NDM) should be considered separately but different species of Enterobacterales carrying the same type of CPE do not need to be considered separately.

Note that after a hospital transitions to endemic status, in the event that the hospital identifies an atypical cluster or pattern of cases of acquisition, emergence of a new type of CPE, or an incidence of acquisition that represents significant variation from baseline it is appropriate to declare a new outbreak.

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Appendices

Appendix 1: CPE Cards - Contact Patients and CPE Patients – information is for admission/reception/administration staff in hospitals, GP practices and community based services

CPE is the newest in a long line of what people sometimes call “superbugs”. When we talk about “superbugs’ we mean bacteria that are hard to kill with antibiotics. Of all the superbugs we have had so far CPE is the hardest to kill with antibiotics. We think the number of people who carry CPE in Ireland is still fairly small (probably 2000 to 3000 people). This means that if we take very good care of people who carry CPE over the next couple of years there is still time to stop CPE becoming very common.

Some patients who have already been identified as either CPE Colonised or as a CPE Contact have been given a card. There are pictures of these cards below. The purpose of the card is to help them tell healthcare workers that they are CPE Colonised or a CPE Contact. CPE Colonised means that they have been proven to carry CPE but it does not mean that CPE is causing an infection.

CPE Contact does NOT mean that they have been proved to carry CPE but that they are at higher risk than most people of carrying CPE because they spent some time in hospital close to a patient who was known to have CPE.

Patients who have been given these cards have been asked to show this card to staff any time they access healthcare. They may show the care to admission/reception/administration staff/doctors/nurses or other healthcare workers.

This note is to tell you what to do if you are shown a “Colonisation” card or a “Contact” card.

Contact Card

Front

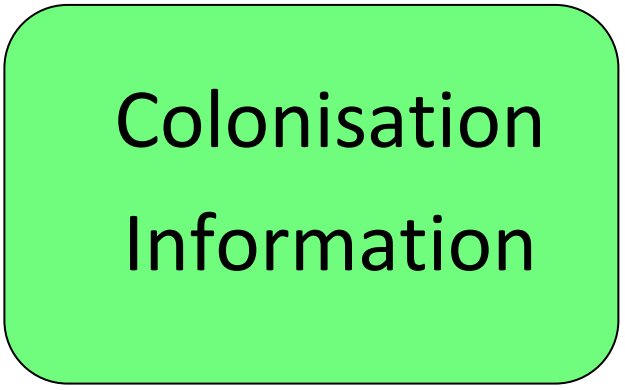
Back

CPE Contact

(Carbapenemase producing Enterobacterales)

Please show this card **immediately** when you arrive at the hospital or visit your GP. This will help the hospital or your GP to follow the correct procedures when treating you. Do this until you have been advised that you are no longer considered a CPE contact. Further information on CPE is available on www.hse.ie/hcai

Colonisation Card



CPE Colonisation

(Carbapenemase producing Enterobacterales)

Always show this card **immediately** when you arrive at the hospital or visit your GP. This will help you to receive the best care and assist the hospital or your GP to follow the correct procedures when treating you.

Further information on CPE is available on www.hse.ie/hcai

People who carry CPE (or any other microbe) or who have been identified as CPE Contacts have equal rights to treatment and services. Their treatment/admission should not be compromised or delayed due to concerns regarding CPE.

Appendix 2: Laboratory Requirements with Respect to Detection of CPE

Conventional culture based technique 1

Note: Commercial selective chromogenic agar that is **optimised for the more common CPE types** should be used. The more common CPE types present, in alphabetical order are KPC, IMP, NDM, OXA-48-like and VIM.

Day 0

This culture based system requires plating of the swab/faeces onto a CPE selective chromogenic agar plate followed by overnight incubation (36±1˚C).

Samples should be set up for culture on the day of receipt 7 days per week.

Note. Some reports indicate that yield of CPE may be higher if samples are enriched in broth containing a carbapenem overnight with subsequent sub culture of the broth to agar plates. If enrichment is used the method of the CDC is appropriate. Each subsequent stage of the culture process will be delayed by 1 day if the pre-enrichment approach is used.

Day 1

Plates should be read on the day after set up seven days per week. The agar plates are inspected for colonies that morphologically resemble Enterobacterales.

If there is NO growth of colonies that morphologically resemble Enterobacterales present and the manufacturers recommended incubation time is 18-24 hours, the laboratory may report as below, however please note that experience in some laboratories suggests that some additional CPE may be detected if plates are re- incubated and read again at 48 hours:

Carbapenemase Producing Enterobacterales NOT detected

If there ARE colonies morphologically consistent with Enterobacterales present on the plate, further identification or a representative of each distinct colonial variant is required. Identification should be by a rapid method such as MALDI-ToF.

Representative growth of each species of Enterobacterales identified should be analysed by a rapid detection assay for the more common carbapenemase specific antigens or genes on Day 1 as soon as sufficient growth permits.

A method capable of giving results within 2-3 hours is required. These include immunochromatograhic assays (lateral flow) and nucleic acid amplification tests (NAAT) or assays.

As outlined above a laboratory should be capable of confirming most isolates of the common CPE types from the day-1 plates on day 1 and of reporting the cultures as CPE-detected.

The commonly available lateral flow assays and NAATs cannot definitively exclude carbapenemase production. If Enterobacterales, in particular *E. coli* and *Klebsiella pneumoniae*, are cultured on the day 1 plate but carbapenemase is not confirmed by the rapid assays, it is appropriate to consider a requirement for precautionary application of contact precautions taking account of local experience with previous

similar isolates.

Day 1 Colonies, Enterobacterales, Not Confirmed as CPE by Rapid Testing

Susceptibility to meropenem and/or ertapenem should be performed by the EUCAST disc diffusion method or by a MIC method capable of differentiating between wild type and non-wild type isolates. (see table 1 for screening cut-off)[2]

Susceptibility testing can generally be set-up on Day 1 direct from the chromogenic agar plate if there is sufficient growth however validation of direct susceptibility in the laboratory is required.

Enterobacterales that are not confirmed as CPE by rapid method but which meet the criteria specified in the user's guide of the National CPE Reference Laboratory Service should be submitted to the National CPE Reference Laboratory Service.

With respect to Enterobacterales that are not confirmed as CPE by a rapid method but which do require submission to the National CPE Reference Laboratory Service it is appropriate to issue an interim report. The content of the interim report should take account of the characteristics of the isolate (for example the species and how high is the MIC), resistance to other antimicrobial agents and recent experience of the laboratory in question with such isolates. In general it may be appropriate to report the isolate as provisional MDRO Enterobacterales as most such isolates are not subsequently confirmed as CPE.

Day 2. Susceptibility Testing should be Read on Day-2 and should be Read Seven Days per Week

The first confirmed CPE of each Enterobacterales species from each person and all isolates from normally sterile body sites should be submitted to the National CPE Reference Laboratory Service within 7 days of isolation.

Suspect CPE should be submitted to the National CPE Reference Laboratory Service within 7 days of isolation.

1.2 Direct molecular testing for CPE technique

Day 0/1

There are a variety of platforms for direct molecular testing with differences in format.

Some are designed primarily for testing large batches together. Others are designed primarily for testing individual samples as they are received (random access).

An assessment of the relative merits of the different systems for direct molecular detection is beyond the scope of this document.

Samples for direct molecular detection should be processed within 24 hours of receipt 7 days per week.

Appendix 3: Antimicrobial susceptibility testing of Enterobacterales which require testing for susceptibility to Carbapenems

Enterobacterales which require testing for susceptibility to carbapenems may be tested by the EUCAST disc diffusion method or by an MIC method capable of differentiating between isolates with an MIC of less than or equal to 0.125 mg/L of meropenem (wild-type) and those with a meropenem MIC of greater than 0.125 mg/L (non-wild type).

Table 1. Clinical breakpoints and screening cut-off values for carbapenemase- producing Enterobacterales[2]

Carbapenem	MIC (mg/L)		Disc diffusion zone diameter (mm) with 10 µg disks	
	S/I breakpoint	Screening cut-off	S/I breakpoint	Screening cut-off
Meropenem	≤ 2	>0.125	≥ 22	< 28
Ertapenem	≤ 0.5	>0.125	≥ 25	< 25

If a commercial automated antimicrobial susceptibility testing (AST system is in place it is important that **user defined alerts are added** in order to alert to a requirement for supplementary testing in isolates that test as susceptible but which are non-wild type.

As per EUCAST[2], meropenem is deemed to be the best balance between sensitivity and specificity in terms of detecting carbapenemase-producers. The NCPERLs recommends that meropenem is the carbapenem of choice for screening for CPE.

It is acknowledged that some laboratories may use ertapenem for screening of CPE, these isolates will be accepted by the NCPERLs for analysis.

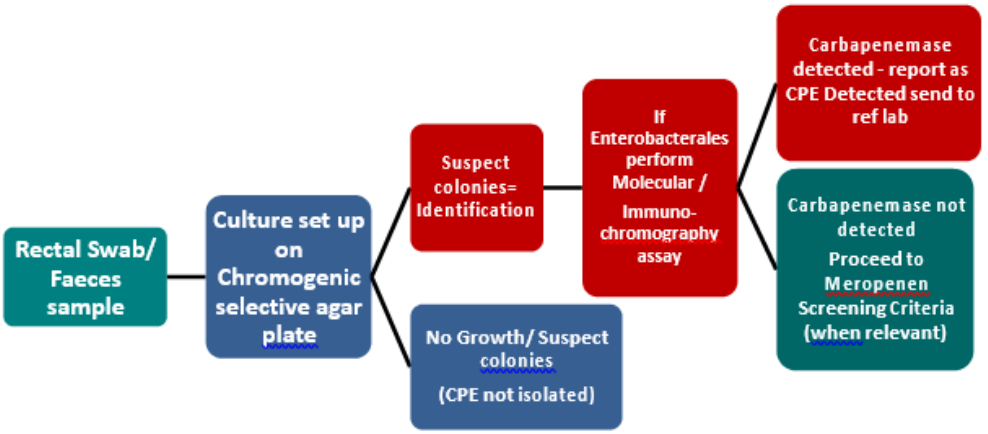
Supplementary Testing

If automated AST systems are used- and the method is not capable of differentiating between wild-type and non-wild-type – use EUCAST disc diffusion or manual M.I.C. for meropenem/ertapenem

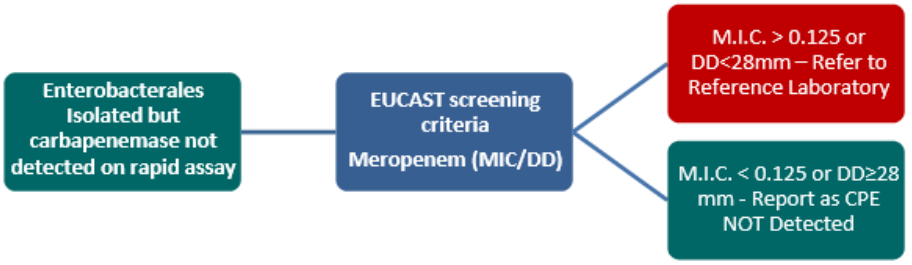
Rapid molecular analysis or immunochromatography assays

Note rapid assays do not detect all CPE types.

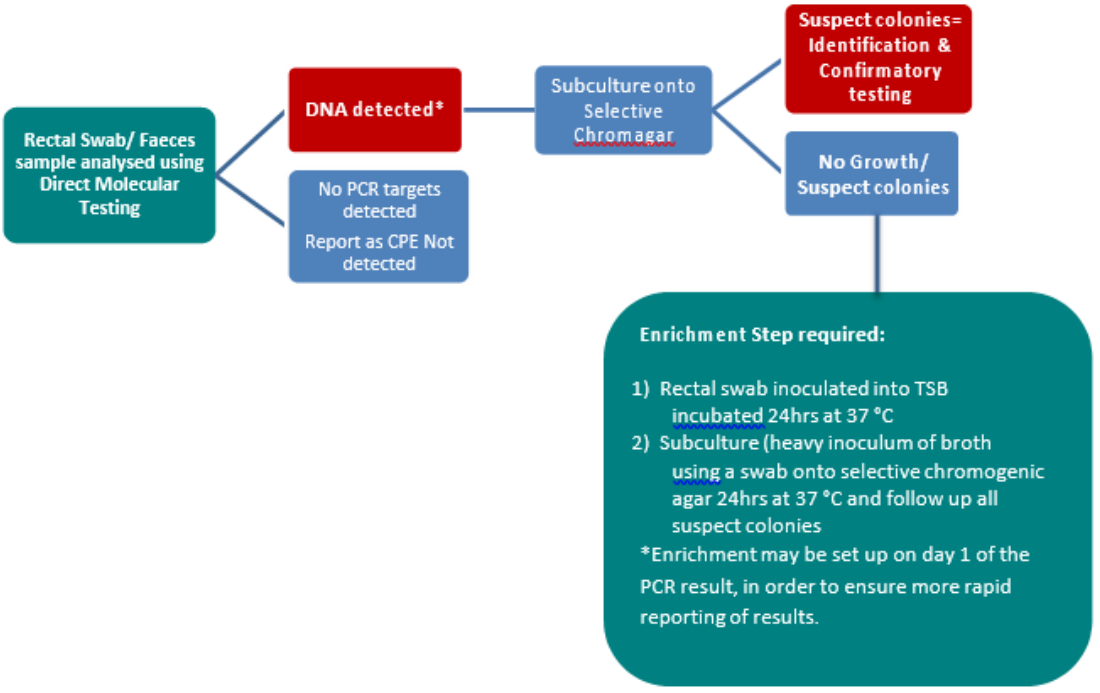
Appendix 4: Algorithm for Carbapenemase Producing Enterobacterales Screening Using Culture Technique



Meropenem Screening Criteria for Enterobacterales Isolates testing as "Carbapenemase not detected:



Appendix 5: Algorithm for Carbapenemase Producing Enterobacterales Screening Using Direct Molecular Analysis



Appendix 6: Technical Note

The following note is relevant to the interpretation of findings of direct molecular positive results that cannot be confirmed by culture of CPE.

The OXA-48 progenitor has been widely acknowledged to be *Shewanella* spp. A number of class D oxacillinase variants have been identified on the organism's chromosome[3]. It is hypothesised that these chromosomal genes, from this environmental organism had been mobilised by addition of an insertion sequence and have been transmitted to Enterobacterales in the form of plasmids[4]. The presence of these chromosomal

progenitors has implications regarding direct molecular testing. One study, Ceccarelli, *et al.* (2017) tested 4,440 faecal samples from animals, fish and environment. Isolates containing blaOXA$_{-48}$-like variants were detected in 92 samples. No Enterobacterales were isolated. *Shewanella* spp. (n=21) were isolated, all of which were confirmed with *bla*$_{OXA-48}$-like genes. Plasmid transformation and conjugation experiments were not successful leading the authors to conclude that the genes were likely to be chromosomal[5].

There have been reports of human intestinal carriage of *Shewanella* spp. simulating carriage of OXA-48 producing Enterobacterales[6]. A patient with previous OXA-48

Klebsiella pneumoniae was tested on subsequent admission, with direct real-time PCR *bla*$_{OXA-48}$-like genes detected. This sample did not yield CPE on selective chromogenic media. Non-lactose fermenting colonies were isolated on McConkey agar within 25mm of the meropenem disc. These identified as *Shewanella putrefacians* and had the *bla*$_{OXA-48}$- like genes detected on real time PCR. Transformation and conjugation experiments were not successful, suggesting chromosomal location of the gene[6]. Subsequent CPE screens from this patient did not detect CPE genes. Transient carriage of *Shewanella* spp. may have potential for causing "false positives" on direct molecular CPE screening assays.

Appendix 7: Communication With People With Molecular Detection of CPE Not Confirmed by Culture

Information generally consistent with the following should be provided to people who have a positive direct molecular test result

1. Direct Molecular Positive – Culture Confirmation Pending

There is a rapid test that shows that you probably are carrying CPE bacteria. This test is usually reliable but we want to do some additional tests to be sure that you have CPE. For the time being we need to work as if you have CPE but we will come back to you in a few days to let you know more and we might need to ask you for another sample.

Other information regarding CPE can be provided as per information leaflets

2. Direct Molecular Positive – Culture Confirmed

The extra work done in the lab shows that you definitely have CPE.

Other information regarding CPE can be provided as per information leaflets

3. Direct Molecular Positive – Unconfirmed by Culture but reproducible positive by a second method or by the same method in a second sample.

With the additional work in the laboratory we have not been able to grow CPE from your sample but the tests for CPE genes are definitely positive. Even though we are not sure you have CPE we think it is safer to take it for the time being that you have CPE and we will offer you some follow up testing once a week for 3 weeks if you have to stay in hospital. If we can't grow the CPE in any of the three/four follow tests we will make decision that you don't have CPE and stop taking extra infection prevention and control precautions during your stays in hospital. You will still be offered testing for CPE though anytime you have to come back into hospital.

Other information regarding CPE can be provided as per information leaflets

4. Direct Molecular Positive – Not reproducible and not culture confirmed.

Based on the extra work done in the lab we have not been able to find CPE in your sample so the result of the first test we talked about was a false alarm (sometimes referred to as a false positive). False alarms sometimes cause upset for people but no test is perfect and almost all tests do give false alarms sometimes. So for now we are making a decision that you don't have CPE. We will stop taking extra infection prevention and control precautions during your stays in hospital. You will still be offered testing for CPE though anytime you have to come back into hospital.

Other information regarding CPE can be provided as per information

Appendix 8: Risk-management: Case study for management of confirmed case of Carbapenemase Producing Enterobacterales (CPE)

A liver transplant patient residing in a two-bed room at a Model 4 hospital is tested for CPE rectal colonisation as part of the hospital's CPE surveillance programme. The two-bed room shares a toilet and shower with an adjacent 2 bed-room. The patient's primary team and the infection prevention and control team are informed by the laboratory that the patient had CPE. The patient was transferred immediately to a single patient room with ensuite facilities. The patient has been an in-patient for 2 weeks prior to test date but had not been tested previously. He was CPE not detected during a previous admission 2 months previously. As such, the period of during which he was likely to have transmitted CPE was considered to be from the beginning of the current admission, until the patient was identified and placed into the single room. He has had no known contact with CPE positive patients. Review of records indicates that another patient with the same type of CPE was identified in the adjacent two-bed room 5 weeks previously.

Case study for management of confirmed case of CPE **Establishing the Context**

The risk of CPE acquisition in acute hospital settings is an established risk in Ireland that hospitals have not been able to eliminate, so it must be managed.

Risk Assessment – Risk identification

In this case, the risk has been identified in the context of a risk incident specifically a known case of CPE that was in a two-bed area and may have acquired CPE in the facility or may have transmitted CPE to other patients in the healthcare facility. Risk identification should not wait for an incident to occur.

Risk Assessment – Risk analysis

One source of the risk is that the patient was sharing a room with multiple other patients. The infected patient is identified as high-risk due to faecal incontinence and wandering behaviours.

The understanding of the risk related to the fact that the patient was not tested for CPE on admission as per national guidelines. The identification of a previous patient with the same type of CPE associated with the same section of the ward raises concern of a possible environmental

reservoir – it is possible that CPE is resident in the ward (typically in the drains/sinks) and that patients are becoming contaminated from this reservoir.

Risk Assessment – Risk evaluation

The balance of likelihood of CPE acquisition and consequences of CPE acquisition identify this as a 'very high risk' situation requiring risk treatment.

Risk Treatment

Immediate measures include:

Primary team should inform the patient that they are CPE positive and what this means for their care and provide relevant printed / on line information.

Arrange for a follow up visit from IPC team members if required and if practical.

Place the patient in a single patient room with their own bathroom.

Implement contact precautions including the wearing of PPE when appropriate.

Limiting patient movement and intensifying routine environmental cleaning.

All healthcare workers should be provided with education about infection prevention and control strategies for CPE.

Review national guidance on measures to prevent transmission of CPE.

Review why testing for CPE was not performed on admission.

The outbreak should be notified to the Department of Public Health.

Other measures

Convene an incident management group /outbreak control team.

Inform the other patients who are identified as contacts (for example because they shared the toilet/shower with the patient in the previous two weeks) that they are CPE Contacts (see national guidance).

Carry out hand hygiene, transmission-based precautions and hygiene audits and check pillow and mattress integrity.

Test other patients at risk for colonisation with CPE to determine the extent of the outbreak.

Consider ward discharge testing for a period of time (for example 4 weeks) to monitor for ward-associated CPE acquisition.

Confirm that the bed-pan washer is working correctly and that all water drainage points are draining quickly and completely.

Sample the environment in particular moist areas in the shared bathroom/toilet.

Send the relevant isolates for typing including environmental isolates if any detected.

Review if antimicrobial use in the unit to asses if there is potential to improve antimicrobial use.

Any patient identified as a contact who is still in the healthcare facility should be placed into single rooms with contact precautions and offered testing for CPE as per national guidelines.

An alert should be placed in their medical history for the CPE case and for CPE Contacts so they can be placed into contact precautions and screening completed if they are readmitted.

Review education and training about the need for CPE screening.

Monitoring and Review

The healthcare facility should implement a surveillance programme to monitor the development of transmission of CPE. Healthcare workers adherence to infection prevention strategies should also be monitored. The surveillance programme should inform subsequent review.

The healthcare facility can also review and monitor their antimicrobial prescription/use trends and use audit systems to identify inappropriate antimicrobial use.

Appendix 9: Checklist for CPE Outbreak Control

Note this checklist is included in this document for illustration purposes.

The checklist can be downloaded as a modifiable word document from the CPE Guidance section of the HPSC website.

Number	Checklist point (brief)	Check/Note
Section A. Informing Key Stakeholders and Notification		
A1	Relevant internal communication	
A2	Notification to the Dept of Public Health	
A3	Inform the HPSC	
A4	Inform HSE-AMRIC	
A5	If HSE-AMRIC support required request same	
Section B. Surveillance		
B1	Convene OCT	
B2	Are OCT meeting sufficiently frequent?	
B3	Are surveillance and microbiology updates available?	
B4	Does OCT Agenda cover key points?	
B5	Do ward staff have updates on status?	
B6	Rapid on site lab confirmation of CPE	
B7	Consider need for epi evaluation	
Section C. Screening and Patient Placement		
C1	Is ward closure necessary? If so, what are re-opening criteria	
C2	Are patients appropriately accommodated?	
C3	Are individual patient needs considered?	

C4	Dedicated equipment for CPE patients	
C5	Check CPE screening practice	
C6	Contacts identified and screened?	

Number	**Checklist point (brief)**	**Check/Note**
C7	Discharged contact are informed	
C8	CPE contacts delisted after 4 samples	
C9	Microbiology laboratory has resources	
C10	Laboratory capacity adequate for weekends	
Section D. Patient Movement		
D1	Limit patient movements	
D2	Limit patient transfers	
D3	Transfers between departments are Planned	
D4	Transfers to other facilities planned and Communicated	
D5	No undue delays in transfers	
Section E. Staff Education		
E1	Training records checked and refresher training provided where necessary	
E2	Additional hand hygiene/IPC audits	
E3	Real time feedback on performance	
E4	Adequate PPE stocks	
E5	Adequate IPC Nursing resources for education	

E6	Check hand hygiene facilities	
E7	Check Toilet Facilities (ref v5 infection control, guidance principles for buildings, acute hospitals and community settings)	
E8	Check sluices, bed pan washers (temperature controls, service records, test soils etc.), bed pans and commodes.	
E9	Consider posting audit scores	
Section F. Communication with staff		
F1	Staff members notified of outbreak	
F2	Town hall meetings considered	
F3	Support for ownership of outbreak	
Number	**Checklist point (brief)**	**Check/Note**
F4	Designated shared folder considered	
F5	Occupation health resourced to support	
F6	Appropriate on-ward signage	
F7	Appropriate signage at ward entry	
F8	Swipe card access activated	
Section G. Communication patients, visitors and public		
G1	Patients are informed promptly	
G2	Patients given CPE/Contact Card	
G3	Use an electronic IPC software of PAS flag if available	
G4	Check documentation on patient Communication	
G5	Consider pro forma to support documentation	

G6	Adequate stock of leaflets and cards	
G7	Patient information on hand hygiene	
G8	Visitor information on hand hygiene	
G9	Short written message for patients	
G10	Hospital communications department proactive	
Section H. Communication between healthcare facilities		
H1	Communication is “need to know”	
H2	Formal record alert for all patients	
H3	Check to ensure function of formal alert process are in place	
H4	Retrospective placement of alerts if Required	
H5	Check discharge letters to GP	
H6	Preformat communication for lead Consultant and GP	
H7	Consider local secure CPE database	
H8	Inform other healthcare facilities of CPE apparently acquired there	
Section I. Environmental Hygiene		
Number	**Checklist point (brief)**	**Check/Note**
I1	Hygiene services on OCT	
I2	Check adequate cleaning and disinfection of environment and equipment	
I3	Check cleaning technique	
I4	Microbiological sampling of the environment	

I5	Consider tools to assess cleaning	
I6	Consider use of a tool to assess equipment cleaning	
I7	Consider novel decontamination systems	
I8	Multidisciplinary hygiene audit teams	
I9	Check integrity of surfaces & fittings	
I10	Check integrity of chair and furniture Coverings	
I11	Check integrity of mattresses & pillows	
I12	Check toilets – ease of cleaning	
I13	Check plumbing conforms to health building note & free draining	
I14	Sampling of drainage points for CPE	
I15	Audit of sluice, bed pan washers etc.	
I16	Ensure all ventilation service records and monitoring records within affected areas are up-to- date and signed-off by technical services department staff.	
Section J. Minimise Clutter		
J1	PPE is easy to access and properly stored	
J2	Unnecessary equipment removed	
J3	Equipment for decontamination appropriately stored	
J4	Old equipment disposed off	
J5	Adequate chairs	
J6	Single room doors closed	
Section K. Minimise Traffic		

K1	Consider additional controls on visiting	
Number	**Checklist point (brief)**	**Check/Note**
K2	Consider cease non-essential services	
K3	Guidance of book return to library	
K4	Review pastoral care services	
K5	Consider volunteer services	
K6	Limit volunteer visits to one person	
K7	Restrict student activity	
K8	End ward rounds on affected ward	
Section L. Antimicrobial Stewardship		
L1	Review consumption data of critical groups	
L2	Ensure communication re restricted and reserved antimicrobials	
L3	Consider removal of certain antibiotics from ward stock	
L4	Report from Pharmacist to OCT	
L5	Consider AMS resource allocation	
L6	Assess for decline in use of restricted agents	
L7	Consult on treatment of infection	
L8	Capture date on outcome of CPE infection	
L9	Provide all data for inclusion in outbreak report	
L10	OCT Agenda to included patients commenced on treatment for CPE	

L11	Review all antimicrobial use and related practices to reduce unnecessary antimicrobial use	
Section M. Resources		
M1	Confirm adequacy of ward resources (human and other)	
Number	**Checklist point (brief)**	**Check/Note**
Section N. Outbreak Closure		
N1	Refer to guidance on assessing end of transmission	
N2	Use templates to inform public health	
N3	Send outbreak report to the Dept of Public Health	