Framework of actions to contain carbapenemase-producing Enterobacterales
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Executive summary

This framework focuses on **carbapenemase-producing Enterobacterales (CPE)**; these organisms spread rapidly in healthcare settings and lead to poor clinical outcomes because of limited therapeutic options. The increased incidence of CPE has significant cost and operational implications for healthcare providers.

Unless action is taken and we learn from experiences elsewhere in the world, rapid spread of CPE will pose an ever-increasing threat to public health and medical treatment pathways in the UK.

The framework sets out a range of measures, that if implemented well, will help health and social care providers minimise the impact of CPE. These include:

- active patient admission screening of risk groups
- rapid detection of patients colonised or infected with CPE, with appropriate surveillance systems to enable ongoing monitoring
- consistent implementation of infection prevention and control practices and contact precautions
- minimisation of CPE reservoirs by effective environmental cleaning and decontamination
- antimicrobial stewardship programmes to minimise inappropriate use of broad-spectrum antibiotics, including carbapenems
- optimised laboratory methods to detect carbapenemase-producing Gram-negative bacteria, including Enterobacterales
- prompt recognition of outbreaks to enable effective management
- organisational ownership to support the implementation of this framework

We recognise that the evidence base for some recommendations is limited and that local risk assessment is important for building a CPE policy relevant to the local situation that can be implemented based on the Framework.

Where there is an evidence base we have referred to this explicitly, other recommendations are based on expert guidance or opinion.
Key recommendations

Based on this developing evidence base there are eight areas with core recommendations that all settings should introduce or further develop:

<table>
<thead>
<tr>
<th>Framework of actions to contain CPE in health and social care settings</th>
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<tbody>
<tr>
<td><strong>Patient screening</strong>*</td>
</tr>
<tr>
<td>• active screening for CPE is recommended to</td>
</tr>
<tr>
<td>minimise transmission from CPE positive</td>
</tr>
<tr>
<td>patients</td>
</tr>
<tr>
<td>• patient screening, the scope of which should</td>
</tr>
<tr>
<td>be guided by local and regional prevalence,</td>
</tr>
<tr>
<td>specific patient populations and risk</td>
</tr>
<tr>
<td>factors, must be implemented alongside</td>
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<tr>
<td>infection prevention and control</td>
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<tr>
<td>interventions</td>
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<tr>
<td><strong>Surveillance</strong></td>
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<tr>
<td>• surveillance systems are needed to rapidly</td>
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<tr>
<td>detect and monitor patients either</td>
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<tr>
<td>colonised or infected with CPE</td>
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<tr>
<td>**Standard infection control and contact</td>
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<tr>
<td>precautions**</td>
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<tr>
<td>• consistent implementation of standard</td>
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<tr>
<td>infection control precautions and contact</td>
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<tr>
<td>(transmission based) precautions should</td>
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<tr>
<td>be employed to reduce the spread of CPE</td>
</tr>
<tr>
<td><strong>Cleaning and decontamination</strong></td>
</tr>
<tr>
<td>• enhanced cleaning processes are required</td>
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<tr>
<td>when CPE positive patients are detected</td>
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<tr>
<td>• this must be undertaken before disinfection</td>
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<tr>
<td><strong>Antimicrobial stewardship (AMS)</strong></td>
</tr>
<tr>
<td>• antimicrobial usage and audit data should be</td>
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<td>reviewed at regular intervals by local</td>
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<tr>
<td>antimicrobial stewardship committees (or</td>
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<tr>
<td>equivalent)</td>
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<tr>
<td>• specific actions should be taken where there</td>
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<tr>
<td>are early signals of increasing antimicrobial</td>
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<tr>
<td>resistance or antimicrobial consumption</td>
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<tr>
<td>trends, particularly broad-spectrum agents</td>
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<tr>
<td>including carbapenems</td>
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<tr>
<td><strong>Laboratory methods</strong>*</td>
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<tr>
<td>• implement molecular or immunochromatographic</td>
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<tr>
<td>assay in frontline diagnostic laboratories</td>
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<tr>
<td>for the detection of KPC, OXA-48-like,</td>
</tr>
<tr>
<td>NDM and VIM carbapenemases to complement</td>
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<tr>
<td>culture-based testing</td>
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<tr>
<td>• refer carbapenem resistant isolates with</td>
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<tr>
<td>local negative tests to detect IMPs and</td>
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<tr>
<td>other rarer carbapenemase families to PHE’s</td>
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<tr>
<td>Antimicrobial Resistance and Healthcare-</td>
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<tr>
<td>Associated Infections Reference Unit</td>
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</tbody>
</table>
Framework of actions to contain carbapenemase-producing Enterobacterales

| Outbreaks and clusters | • a prompt response following detection of CPE in health/social care settings is required to minimise onwards transmission  
|                         | • environmental samples should only be taken when epidemiologically indicated |
| Organisational responsibilities | • organisational leadership should support the infection prevention and control programme by providing organisational and administrative support. |

*not applicable outside of acute providers of care*
Section 1. Context and background

1.1 Rationale for update

This document is an update of the Acute trust toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae\textsuperscript{1} and the Carbapenemase-producing Enterobacteriaceae: non-acute toolkit.\textsuperscript{2} Stakeholders had requested one document to replace the two toolkits that provides a framework of actions for all health and social care providers in a simplified format. An evaluation of the acute toolkit was undertaken in 2016 (1). The results of this have informed the development of this framework. The objectives of the framework are to:

- provide a framework of actions and tools to support health and social care providers
- support development of local guidance and tools for the early detection of CPE with the aim of preventing transmission and containing their spread for the safety of patients and the wider population
- direct health and care professionals to the relevant guidelines for laboratory methods, including reporting of results to PHE

1.2 Document scope

There is significant uncertainty regarding the most effective measures to minimise the transmission of CPE, and the evidence base is constantly evolving. This framework aims to provide health and social care organisations with a useful and pragmatic set of actions to support the implementation and monitoring of interventions to prevent and control the spread of CPE.

This document refers to CPE alone; although some interventions may be common to other carbapenem-resistant Gram-negative bacteria such as carbapenem-resistant \textit{Pseudomonas} spp. and \textit{Acinetobacter} spp., these are not included within the document given the differences in epidemiology, microbiology, transmission, and environmental persistence. In 2017, the World Health Organisation produced detailed guidance (2) on prevention and control of these organisms in healthcare settings, in addition to CPE.

Many elements of the framework are equally applicable to all providers of health and social care; where actions relate to a specific sector this will be clarified.

1.3 What are carbapenemase-producing Enterobacterales?

Recent taxonomy changes have included the family Enterobacteriaceae within the order Enterobacterales. Enterobacterales are a large family of bacteria that usually live harmlessly in the gut of humans and animals. They include species such as Escherichia coli, Klebsiella spp. and Enterobacter spp. However, these organisms are also some of the most common causes of infections, including urinary tract infections, intra-abdominal and bloodstream infections.

Carbapenems are a valuable family of β-lactam (penicillin-like) antibiotics normally reserved to treat serious life-threatening multidrug-resistant Gram-negative infections in hospitals. They include meropenem, ertapenem, imipenem and doripenem.

Resistance to some or all carbapenems is an intrinsic (natural) characteristic of some Gram-negative bacteria. Others can produce carbapenemases, which are enzymes that destroy carbapenem antibiotics, conferring resistance. This document focuses on acquired carbapenemases, a particular concern as these genes (usually located on mobile elements such as plasmids) can move vertically (within a strain) and horizontally (between strains, species and genera).

Enterobacterales producing acquired carbapenemases are referred to as CPE. KPC, OXA-48-like, NDM, VIM, and IMP enzymes are the most prevalent enzymes in the UK. Increasing gut colonisation with these resistant bacteria will inevitably lead to an increase in difficult-to-treat infections. Figure 1 illustrates the relationship between CPE and other carbapenem-resistant and carbapenemase-producing Gram-negative bacteria.

1.4 Importance of controlling CPE

Unless action is taken and lessons are learnt from experiences elsewhere in the world (see Appendix A for guideline comparison), rapid spread of CPE will pose an increasing threat to public health and medical treatment pathways in the UK. These resistant bacteria can spread rapidly in healthcare settings. Almost all acute healthcare providers in England have
identified at least one new patient colonised with CPE in the last year; at least half have identified multiple positive patients (3).

Invasive infections with CPE increase both patient length of stay, as a consequence of morbidity, and mortality, compared to bacteria not carrying resistance markers (4, 5). Additionally, large outbreaks in the UK have led to substantial costs (both healthcare, staffing and other resources) given the time taken to achieve control once the outbreak is established. In some health and social care organisations in England, CPE are now endemic.

An understanding of local epidemiology and context is key, as public health actions will differ depending on:
- the prevalence of CPE in patients being admitted to healthcare settings
- prior outbreaks within the region
- the patient population mix including number of overseas patients or repatriations of patients from hospitals abroad
- individual risk assessments of areas where transmission is most likely to occur

Healthcare providers who have considerable experience of CPE outbreaks may develop contextualised screening strategies reflecting their local epidemiology.

1.5 Implementation of the CPE Framework: benefits and costs

The operational challenges of implementing this framework cannot be underestimated. It will require board and senior management level commitment and support to ensure capital and recurrent funding required to sustain the range of recommended interventions.

It is widely acknowledged that the cost of managing episodes of CPE in healthcare settings can be considerable. A US study estimated the cost of managing a single case to be between $22,484 to $66,031 for hospitals (6). A European study that assessed the cost of implementing strict measures to eradicate multi-drug resistant infections (including CPE) estimated that this ranged from €285 to €57,532 per positive patient (7). One UK study estimated the cost of a CPE outbreak where 40 patients identified as infected or colonised over 10 months at £1 million (8). The cost included the actual expenditure to control the outbreak as well as the “opportunity” costs such as lost revenue due to ward closures.

Modelling work from Canada suggests universal CPE screening is potentially cost-effective, even at a lower prevalence than currently reported in England,
Framework of actions to contain carbapenemase-producing Enterobacterales

and identified conditions where a colonised patient infects one other patient at a very low prevalence under which it would become cost saving compared to not screening (9). More generally, it is expected that suitable selection criteria would enhance the cost-efficiency of screening.

While there are no studies determining the optimal measures to prevent and control CPE, managing CPE outbreaks carries considerable costs – financial, logistical, and reputational.
Framework of actions to contain carbapenemase-producing Enterobacterales

Figure 1: Explanation of different terminology for various carbapenem resistance mechanisms and nomenclature

Carbapenem-resistant Gram negative bacteria can be naturally resistant to carbapenems such as *Stenotrophomonas maltophilia* OR they can acquire carbapenemase genes, which typically (but not always) confer carbapenem resistance.

Carbapenem-resistant Enterobacterales (CRE) refers to a particular type of Gram negative bacteria.

Resistance can be caused by carbapenemases, which would make them carbapenemase producing Enterobacterales (CPE).

There are also other carbapenemase producing non-Enterobacterales Gram negative rods.

CPE are regarded as the biggest threat as the resistance genes can transmit vertically and horizontally, thereby rapidly spreading between different strains of bacteria.


* Modified from *Antimicrobial Resistance & Prescribing Programme (HARP team), Public Health Wales. All Wales Guidance for Developing Policies and Procedures to Manage Multi Drug Resistant Organisms (MDRO) including MRSA. Cardiff: PHW, 2018*. This is a visual representation and circle size/alignment may not fully represent specific characteristics.
Section 2. Who to screen and why

Box 1: New evidence and recommendations for screening patients for CPE

<table>
<thead>
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<th>New evidence since publication of previous guidance</th>
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<tr>
<td>• Patients are colonised with CPE prior to developing an invasive infection (10-12).</td>
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<tr>
<td>• The aim of active screening is to prevent transmissions and the number of colonised patients at risk of invasive infection.³</td>
</tr>
<tr>
<td>• CPE screening can be cost effective (9).</td>
</tr>
<tr>
<td>• Serial admission screening for CPE does not improve the rate of detection (13).</td>
</tr>
<tr>
<td>• Identifying patients colonised with CPE is optimised by taking rectal swabs (14).</td>
</tr>
<tr>
<td>• Increasing evidence of colonisation with CPE following travel abroad (10, 15-18).</td>
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<table>
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<tr>
<th>Key recommendations</th>
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<tr>
<td>• Acute care providers should actively screen patients at risk of colonisation.</td>
</tr>
<tr>
<td>• Screening strategies (including ongoing screening) should be based on local epidemiology and patient mix.</td>
</tr>
<tr>
<td>• Close contacts of cases should be screened.</td>
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<tr>
<td>• Enhanced screening should be conducted during outbreaks.</td>
</tr>
<tr>
<td>• Rectal swabs should be taken for screening purposes (include wounds and urine [if catheterised]).</td>
</tr>
<tr>
<td>• Include CPE status (ie positive/negative) on discharge summary if patient has been screened during admission.</td>
</tr>
<tr>
<td>• Screening of staff is not recommended.</td>
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2.1 Introduction

Colonisation usually precedes infection. Early identification of patients colonised or infected with CPE can help minimise transmission and inform therapy and early interventions to prevent invasive infections. (9-11, 19).

³ Approximately 1 in 200 patients with ESBL colonisation progress to ESBL blood stream infection each year; applying similar proportions to CPE, with the currently detected 100 BSI each year there are approximately 20,000 colonised patients in England.
2.2 Active screening for CPE

Each patient should have a clinical risk assessment to determine those at higher risk of CPE colonisation on admission, readmission or transfer from another healthcare facility (20). Active screening for CPE is recommended to:

- minimise transmission from CPE positive patients
- minimise the risk that colonised patients will develop clinical infections eg from invasive devices
- ensure appropriate surgical prophylaxis and prescribing of effective antibiotic therapy if clinical infection develops (see section 6.5)
- minimise environmental contamination and the development of potential reservoirs

Note: Healthcare providers may wish to treat patients that have been previously identified as CPE positive as persistently colonised regardless of screening, though the evidence base for this is limited and is likely to change as knowledge evolves.

The evidence to inform CPE screening strategies is limited and the recommendations included in this framework are consistent with international guidelines (2, 20-23) and UK expert consensus.

2.3 Key risk factors for CPE colonisation or infection

2.3.1 Admission screening to acute care providers

Acute trusts will need to make their own risk assessment based on regional prevalence, patient mix, and linkages with other care providers.

The following patients should be strongly considered for screening on admission if they are likely to stay in hospital overnight (22, 24), if:

- in the last 12 months, they have:
  - been previously identified as CPE positive (13, 25, 26)
  - been an inpatient in any hospital, in the UK or abroad (25, 27-30)
  - had multiple hospital treatments eg are dialysis dependent (25, 29, 31)
  - had known epidemiological link to a known carrier of CPE (25, 32)

\[4\] A previously positive patient may be negative on the first screen but may become positive later in admission eg after a course of antibiotics.
they are admitted into augmented care or high-risk units (29, 33-35) (see Box 2).

**Box 2: Definition of augmented care/high risk settings and comorbidities (adapted from DH MRSA 2014 and Water systems - Health Technical Memorandum 04-01)**

For the purposes of this document, the patient groups in augmented care/high risk scenarios include:

- those patients who are severely immunosuppressed because of disease or treatment: this will include haematology/oncology and transplant patients and similar heavily immunosuppressed patients during high-risk periods in their therapy
- those cared for in units where organ support is necessary, for example critical care (adult, paediatric and neonatal), renal (including dialysis settings), respiratory or other critical care or intensive care situations
- those patients who have extensive care needs such as liver units and patients with breaches in their dermal integrity, such as in those units caring for burns

An increased prevalence of CPE in a hospital in the same region (specifically with the same referral network of patient referrals) increases the risk of positivity (36).

Based on the epidemiology of the admission unit, patients that may be at an increased risk and should also be considered for screening include those:

- with immunosuppression (29)
- with exposure to broad-spectrum antibiotic courses (such as cephalosporins, glycopeptides, and piperacillin/tazobactam) (31, 34), and in particular carbapenems (29) within the past one month (37), not covered in other risk groups eg those receiving OPAT
- admitted from Long Term Care Facilities where higher levels of interventional care are provided eg long-term ventilation (24, 29)

There is also increasing evidence that international travel is a risk for acquisition of resistant Gram-negative organisms including CPE in many countries across Europe (10, 15, 37), including the United Kingdom (16), and particularly from the Asian subcontinent (17, 18). Though this does not form part of taking a routine patient history outside of infectious disease settings, acute healthcare providers should make efforts to capture this information when conducting admission screening risk assessments.
Appendix B provides a reminder acronym for admission screening and Figure 2 provides a summary for admission and on-going screening strategies.

Routine screening for primary care settings or on admission to a care or residential home is not recommended. Acute healthcare providers need to undertake a risk assessment to determine if other groups of patients require admission screening based on the local incidence of CPE, patient acuity, the level of care, interventions and carbapenem usage.

It is usually not feasible, due to a lack of single rooms, to place patients in pre-emptive isolation whilst waiting for the result of their screen (38, 39). When a single room is not available, use standard infection control precautions (SICP) and contact (transmission based) precautions in a multi-occupancy bay setting until screening results available (see Section 4 for detail). Local risk assessment will determine which patients are priority for a single room eg patients transferred from hospitals overseas (see Appendix C).

Active screening for CPE carriage is not usually required in outpatient departments or ambulatory care unless there is evidence of transmission in these settings. However, CPE status should be recorded on the discharge summary and/or patient transfer documents if the patient has been screened during their admission.

**Figure 2: Algorithm for admission and on-going screening strategies**
2.3.2 On-going screening

The evidence base to inform on-going screening strategies is limited, however the options listed below may help local decision making.

There is evidence that serial admission screening (repeat screening separated by specified time points) for CPE does not improve the rate of detection. However, repeat screening of long-stay patients may improve the identification of antibiotic-resistant Gram-negative bacteria (13).

Repeated screening of individual patients may detect patients who were previously not recognised as carrying CPE in certain situations such as for long stay patients on augmented care/high risk units, on units where there is high usage of carbapenem antibiotics or in a setting of transmission (26, 40, 41). Some trusts have implemented repeat screening after 28 days in their high-risk areas. However, implementing repeated screening of individuals based on their length of stay is challenging, therefore some high-risk units undertake weekly or monthly screening to ensure early detection of new cases of CPE. Periodic point prevalence studies of these units are an alternative approach advocated by other guidelines (21, 23).

Once an in-patient is found to be CPE positive, no further screening is necessary during their inpatient stay, as repeated screens of the same patient usually remain positive for CPE over the course of a single hospitalisation (42). CPE carriers should be clearly identified on patient records or electronic systems (case flagging). The patient’s GP should also be informed about their colonisation or infection status by the provider of services who took the sample, and this information should also be included on any inter-hospital transfer information or for a future admission to another hospital.

Evidence suggests that colonisation with CPE extends at least through a single hospitalisation and could extend between multiple hospitalisations (42, 43), although a recent paper found that three quarters did not have detectable CPE on readmission screening (26).

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5 For more detailed information on the burden of carbapenem resistance see the English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) report https://www.gov.uk/government/publications/english-surveillance-programme-antimicrobial-utilisation-and-resistance-espaur-report
2.3.3 Definition of a close contact for screening purposes

A CPE contact is defined as a patient who has been in direct (for example person-to-person contact) or indirect contact (for example contact with contaminated environment or equipment) with another patient who is affected by CPE (infected or colonised) and is therefore at risk of CPE carriage and should be screened.

The definition of a CPE contact will depend on several factors, including:
- the setting
- clinical scenario
- type and length of exposure

CPE contacts are most commonly defined as having shared the same clinical space (eg bay or less commonly ward) as a known CPE carrier. Outside the hospital environment these could also include a person living in the same house or care home, or sexual partner.

2.3.4 Screening outside of acute care

Outside of the acute care sector, screening strategies should be based on the local epidemiology, patient acuity and level of interventions, such as long-term ventilation and rehabilitation facilities (see Appendix D). PHE Health Protection Teams can assist with local risk assessments. They can also liaise with Local Authority Health Protection Team/Community Infection Prevention and Control Team where these exist.

2.4 Outbreak screening strategy

Bay or unit contacts of patients newly identified as CPE positive need to be screened to detect possible transmission as further carriers may be detected. The number of contacts to be screened will be determined by the hospital infection prevention and control team on a case-by-case basis based on proximity to the index case, duration of exposure, and shared staff. In high-risk units, hospitals should strongly consider screening all patients on these wards.

When CPE positive patients are found among screened contacts, the strategy for further screening of patients needs to be expanded.

An enhanced period of screening is recommended during the outbreak period. As an example, the patients in the affected unit/bay/ward should be screened twice a week for two weeks, and weekly for a further two weeks.
Framework of actions to contain carbapenemase-producing Enterobacterales

Once no new cases are detected the frequency of screening may be reduced and stopped at an appropriate point in time after no further cases have been detected. While there is no evidence to suggest how long this should be, experience with other resistant bacteria would suggest a pragmatic period of between 4 and 8 weeks.

Screening of patients already discharged from an outbreak ward to their usual home setting is not generally recommended. However, flagging of households can alert patients requiring screening on (re-)admission to hospital. Information on the patient’s potential exposure to CPE should be included on any inter-hospital or intra-hospital transfer documents and/or discharge summary to alert relevant healthcare providers (including GPs).

2.5 Screening swabs

Rectal specimens are most sensitive for detecting the carriage of antibiotic resistant-Enterobacterales (14). If a screening sample is required, the following optimise the ability of the lab to detect the presence of CPE:

A rectal swab, making sure faecal material and/or discolouration is visible on the swab (a stool specimen if a rectal swab is not feasible or acceptable)

And:

A wound swab and/or a urine sample (if catheterised)

A rectal swab is a specimen taken by gently inserting a swab inside the rectum 3-4cms beyond the anal sphincter, rotating gently and removing. Normal saline can be used to moisten the swab prior to insertion. The swab should have visible faecal material to enable organism detection in the laboratory.

A single rectal screening swab is sufficient to determine CPE colonisation status on admission unless patients have been previously identified as CPE positive. Hospitals may wish to treat these patients as persistently colonised regardless of screening, though the evidence base for this is limited and is likely to change as knowledge evolves.
Framework of actions to contain carbapenemase-producing Enterobacterales

2.6 Staff screening

Staff screening is not recommended. There is no evidence of effectiveness and it is not recommended in international guidelines (44, 45) or by UK experts.
## Section 3. Monitoring and surveillance

### Box 3: New evidence and recommendations for monitoring and surveillance of CPE

<table>
<thead>
<tr>
<th>New evidence since publication of previous guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• horizontal transfer of carbapenemases means that surveillance systems need to monitor patients colonised and/or infected with different bacteria (46, 47).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>All healthcare providers:</td>
</tr>
<tr>
<td>• real-time surveillance systems should be in operation to rapidly detect patients either colonised or infected with CPE</td>
</tr>
<tr>
<td>• surveillance definitions should be clear and based on acquired carbapenemases</td>
</tr>
<tr>
<td>• analyse data regularly (at least monthly) to improve case finding within the organisation</td>
</tr>
<tr>
<td>• maintain a database of known cases and their contacts, that is accessible to those who need to make decisions on isolation and screening within the organisation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital settings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• flag patients with history of or exposure to CPE so that they can be isolated and/or screened as appropriate on readmission.</td>
</tr>
<tr>
<td>• track colonised patients and contact movements within organisations to identify common epidemiological links and potential transmission routes.</td>
</tr>
<tr>
<td>• employ laboratories that report phenotypically-resistant Gram-negative bacteria AND those identified as acquired carbapenemase producers.</td>
</tr>
<tr>
<td>• report acquired carbapenemase producers to PHE’s national microbiological surveillance system</td>
</tr>
</tbody>
</table>

### 3.1 Introduction

Surveillance and monitoring of CPE is important for rapid identification and control. Surveillance is a fundamental aspect of infection prevention and control activities, particularly during outbreaks.

### 3.2 Surveillance systems

Surveillance systems are needed to rapidly detect patients either colonised or infected with CPE. In addition to active patient screening (section 2.2), systems and processes to continuously monitor, review and analyse data are
essential for robust surveillance of CPE (48). These systems should focus on resistance mechanisms, rather than bacteria, as carbapenemase genes can transfer between genera (46, 47, 49).

Most laboratories and IPC teams will have electronic systems for alert organism surveillance. These systems should be configured to detect potential cases (ideally based on molecular detection of CPE genes, but as a minimum based on carbapenem susceptibility testing) and monitor laboratory confirmed cases.

Automated alerts based on laboratory data should be a key part of such systems to ensure deviations from the norm can be identified eg observed increase in proportion of CPE screens that are positive.

Diagnostic laboratories are well-placed to support local non-acute settings in the rapid identification of clusters or outbreaks in their locations and therefore consideration should be given to how to identify and proactively communicate abnormal findings to these settings.

Your local Public Health England Field Service Team can advise on data collection approaches.

3.3 Monitoring

Databases of cases (and close contacts) should include patient demographics, specialties, locations, procedures and bed movements, specimen date and date of onset of infection (if applicable). Computerised patient administration systems may facilitate this.

To ensure ongoing monitoring of CPE cases and contacts, patients with history of or exposure to CPE should be flagged on administrative systems so that they can be isolated and/or screened as appropriate on readmission. This should involve flagging the address of CPE positive patients to allow rapid identification of close contacts outside acute healthcare settings.

3.4 Reporting of surveillance data to Public Health England

Public Health England monitor the incidence and prevalence of many infectious diseases including CPE to track the threat at national and regional levels. Data for this are obtained from local laboratories.

‘Acquired carbapenemase-producing Gram-negative bacteria’, which includes CPE, has been added to the list of causative agents under Schedule
Framework of actions to contain carbapenemase-producing Enterobacterales

2 of the Health Protection (Notifications) Regulations 2020. 6 From 1 October 2020 diagnostic laboratories must ensure that their laboratory information management systems are capable of reporting acquired carbapenemase producers isolated from human samples to PHE’s national microbiological surveillance system (Second Generation Surveillance System, SGSS). These data are required to monitor and track carbapenemase activity across the country.

Further to this, from 1 October 2020 diagnostic laboratories in England have a duty to report the results of any antimicrobial susceptibility test and any resistance mechanism identified in any of the causative agents listed in Schedule 2 of the Regulations, where this is known to the operator. Again, this information should be reported via SGSS.

6 http://www.legislation.gov.uk/uksi/2020/674/made
Section 4. Minimising transmission

Box 4: New evidence and recommendations for how to minimise transmission

New evidence since publication of previous guidance
- Infection prevention and control measures including hand hygiene have led to a reduction of CPE in endemic settings (50-52)
- Transmission to other patients is reduced with the consistent application of standard infection control practices and use of contact precautions where required (24, 28, 53-55)⁷
- Appropriate use and prioritisation of isolation facilities can help control transmission, especially where used together with dedicated staff to care for patients colonised or infected with CPE (53, 54)
- The genes conferring carbapenem resistance are transmitted between bacteria living in patients and the environment (56)

Key recommendations
- In acute care facilities all inpatients screened for or known to be CPE positive should be managed in a single room with en-suite facilities, where possible
- If isolation is not possible, patients with the same carbapenemase enzyme and organism can be cohorted within one ward (or defined area of a ward)
- Areas where patients undergo diagnostics and/or procedures should place CPE positive patients at the end of the day’s list to allow for thorough cleaning and decontamination of the environment
- Decolonisation of CPE positive patients is not recommended
- In a shared care environment, a CPE carrier who is not at high risk of spreading CPE to others does not need to be isolated
- Non-acute settings should not refuse admission or readmission of service users on the grounds that they are colonised with CPE

4.1 Introduction

People who are colonised or infected with CPE act as reservoirs for transmission to others, leading to the possibility of further colonisations, infections or outbreaks. Colonisation pressure is the likelihood of a patient

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⁷ The evidence base for individual IPC interventions is lacking because they should be implemented together [World Health Organization. Guidelines for the prevention and control of carbapenem-resistant Enterobacteriaceae, Acinetobacter baumannii and Pseudomonas aeruginosa in health care facilities. World Health Organization Guidelines. 2017]
coming into contact with a colonised patient. This can rapidly change
dependent on the number of colonised patients on a ward or unit; where the
number of colonised patients is high, there is a greater chance of nosocomial
transmission occurring.

Preventing onward transmission is crucial in containing CPE. This section
outlines the interventions required to prevent transmission between patients,
and from patients to the environment or equipment. See Section 5 for
detailed information on cleaning and decontamination.

4.2 Standard infection control precautions and contact precautions

Standard infection control precautions (SICP) and contact (transmission
based) precautions should be used for patients suspected or known to be
CPE positive (Boxes 5 and 6). Staff should apply contact (transmission
based) precautions in the acute healthcare setting and on a risk assessment
basis outside acute settings for patients infected or colonised with CPE,
particularly where there is a presence of wound drainage, diarrhoea or faecal
incontinence. In these settings, there is increased potential for environmental
contamination and subsequent risk of transmission. For patients with profuse
diarrhoea, appropriate medical management and enhanced cleaning of
lavatory facilities should be undertaken.

Local IPC policies should reflect all relevant Health Technical Memoranda for
waste management and linen.

See Appendix E for a flowchart summary of IPC measures.

8 The Scottish National Infection Prevention and Control manual (www.nipcm.hps.scot.nhs.uk) is to be
adopted across England as set out in the AMR National Action Plan 2019-2024 - there are some
changes to terminology that differ from previous understanding within national policy that will now
mirror those in the NIPCM
Box 5 - Standard infection control precautions

Used by all staff, in all care settings, at all times, for all patients whether infection is known to be present or not to ensure the safety of those being cared for, staff and visitors in the care environment

Hand hygiene

Respiratory and cough hygiene

Personal protective equipment which includes:

- gloves
- aprons
- long sleeved gowns to be worn where any part of the uniform (work wear) is not adequately protected by an apron eg turning patient, or where there is a risk of extensive splashing of blood and/or other body fluids eg excessive wound exudate, diarrhoea, faecal incontinence

Safe management of care equipment

Safe management of the care environment

Safe management of linen

Safe management of blood and body fluid spillages

Safe disposal of waste (including sharps)

Occupational safety: prevention and exposure management (including sharps)

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9 Adapted from www.nipcm.hps.scot.nhs.uk
10 Standard infection control precautions: national hand hygiene and personal protective equipment policy (2019).
https://improvement.nhs.uk/documents/4957/National_policy_on_hand_hygiene_and_PPE_2.pdf
Box 6 - Contact precautions

Used to prevent and control infections that spread via direct contact with the patient or indirectly from the patient’s immediate care environment (including care equipment).

- Patient placement/assessment for infection risk
- Safe management of patient care equipment in an isolation room/cohonen area
- Safe management of the care environment
- Personal protective equipment: respiratory protective equipment [not routine for CPE patient care]
- Infection prevention and control during care of the deceased

4.3 Visitors

Visitors who are not providing any patient care and who are not visiting other patients in the hospital do not need to wear gloves or an apron/gown. However, they should clean their hands on leaving the room. If visitors are taking an active part in the patient’s care, SICP should be used. Visitors should not use patient toilet facilities.

4.4 Isolation

In acute care facilities all inpatients who have been screened for or have confirmed CPE should be managed in a single room with en-suite facilities, where possible. If the single room does not have en-suite facilities, a commode or dedicated toilet should be assigned to the patient. Reusable bedpans, commode pots and bedpan holders should be decontaminated in an automatic washer disinfector.

If single rooms are not available for every screened or known CPE-positive patient a risk assessment should be undertaken by the IPC and clinical teams to determine where to care for patients (38, 39). Single rooms should be prioritised based on:

- patient characteristics, particularly those presenting an increased risk of secondary transmission, such as patients who have diarrhoea, or are incontinent, have wounds with uncontrolled drainage, or are colonised in their respiratory tract and who are coughing
Framework of actions to contain carbapenemase-producing Enterobacterales

- patient’s level of self-care and type of stay (pre-operative/day case/admission/intensive care)
- screening results (‘high-risk’ patients or confirmed positive)

This also applies to outpatient investigations or procedures, including day surgery unit visits and ambulatory care.

See Appendix F for risk assessment where isolation rooms are limited.

4.5 Cohorting

Cohorting for CPE is recommended as a second line if isolation is not feasible. This should be considered as a pragmatic alternative to isolation when there is an increase in the number of patients with CPE in a defined clinical area/speciality, on the advice on infection control specialists.

Patients with same acquired carbapenemase enzyme and organism can be cohorted within one ward (or defined area of a ward) with dedicated bathroom facilities, equipment and staffing. Patients or residents with different mechanisms of resistance should not be cohorted together.

The following need to be assessed when agreeing cohorting arrangements:

- duration of length of stay of patients and clinical need
- enhanced IPC support for staff including education, training and monitoring of compliance with contact precautions
- increased environmental cleaning of the cohort area
- ability to provide a dedicated cohort of nursing staff over 24 hours
- geographical location of cohort area including dedicated toilet/bathroom facilities
- provision of dedicated patient-shared equipment (disposable where possible)
- if the cohort area is part of a ward (rather than the whole ward), consider CPE screening of patients in other parts of the same ward as an indication of onward transmission
- impact on patient flow across the wider organisation

4.5.1 Where cohorting is not an option

Where patient isolation or cohorting is not feasible, management of CPE positive patients may sometimes require the application of SICP and contact (transmission based) precautions in a multi-occupancy bay. Patients should remain under contact precautions for the duration of their inpatient stay.
Patients in the same bay should be regarded as CPE contacts, and have CPE screens when moving to other wards or acute care providers.

Close contacts should be risk assessed to determine patient placement whilst awaiting screening results eg faecal incontinence. If they are discharged before screening is performed, close contacts should have their patient records flagged for CPE screening on readmission to acute care hospitals.

Risk assessments should be regularly reviewed eg wards that have a concurrent norovirus outbreak and have a patient colonised with CPE being managed in an open bay will need to revise the appropriateness of this approach.

There may be unique scenarios that warrant specific consideration eg paediatric settings (see Appendix G).

4.5.1 Other settings

In outpatient settings and ambulatory care settings, faecally continent patients with CPE who have no other risk factors, present a very low risk of transmission and therefore isolation or cohorting are not routinely required. However, where feasible their close contacts should be their records flagged for admission CPE screening to acute care hospitals. In contrast, CPE colonised patients with diarrhoea pose a greater risk of transmission and, environmental and equipment decontamination will be required following their visit.

4.6 Patient movement

Should the patient require a diagnostic test or procedure, this should be undertaken in the patient’s room if possible. If not, the procedure should be planned at a time when decontamination of equipment and the environment can be undertaken after the patient has vacated the area. It is recommended to remove any equipment not needed for the procedure from the room to aid cleaning.

Areas where patients undergo diagnostics and/or procedures, including operating theatres, should aim to place CPE positive patients at the end of the day’s list to allow for thorough cleaning. However, patient care should not be compromised. Where possible, CPE positive patients should have separate waiting and recovery areas to reduce any possible environmental contamination and subsequent transmission.
4.7 Decolonisation of patients

Although colonisation with CPE increases the risk of developing infection, decolonisation is not recommended and may increase the risk of inducing antimicrobial resistance (57). Reduced susceptibility to chlorhexidine has been reported in Gram-positive and Gram-negative bacteria; the clinical significance of this reduced susceptibility, which is below in-use concentrations of chlorhexidine, is unclear (58, 59). There currently is insufficient evidence to recommend either skin or gut decolonisation of patients infected or colonised with CPE.

4.8 Non-acute care settings

Non-acute settings should not refuse admission or readmission of service users on the grounds that they are colonised with CPE. Furthermore, discharge should not be delayed until an infection has resolved if the patient is well enough to be discharged. Good communication will prevent unnecessary anxiety, misunderstanding or confusion for the family or healthcare facility receiving the patient.

In a shared care environment, a CPE carrier who is not at high risk of spreading CPE to others does not need to be isolated and should be allowed to use communal facilities. If possible, the individual should be accommodated in a single room with en-suite facilities. If not possible, they should not share a room with an immunocompromised individual or those with other risk factors such as chronic wounds.

Those at high risk of infecting others eg with uncontrolled faecal incontinence should have their care activities undertaken in a single room with en-suite facilities. If an en-suite room is not available, the individual should be placed in a single room with a designated commode with easy access to hand washing facilities.

In outpatient and ambulatory care settings, faecally continent patients with CPE who have no other risk factors present a very low risk of transmission and therefore isolation or cohorting are not routinely required. In contrast, CPE colonised patients with diarrhoea pose a greater risk of transmission; environmental and equipment decontamination will be required following their visit.

Determining if someone is a high risk of infecting others is based on a risk assessment. The local Health Protection Team can provide advice on this, or Community Infection Prevention and Control specialists if available.
Section 5. Cleaning and decontamination

<table>
<thead>
<tr>
<th>Box 7: New evidence and recommendations for cleaning and decontamination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New evidence since publication of previous guidance</strong></td>
</tr>
<tr>
<td>• transmission to other patients is reduced through appropriate ward and equipment cleaning and disinfection, appropriate waste disposal, education of staff, audit of processes and feedback (24)</td>
</tr>
<tr>
<td>• effective cleaning of high-touch surfaces and management of environmental reservoirs will minimise spread of gut flora and transmission to subsequent room residents (60, 61)</td>
</tr>
<tr>
<td>• environmental reservoirs can be difficult to eradicate; such reservoirs include sinks, drains, and other water sources (62-65)</td>
</tr>
<tr>
<td><strong>Key recommendations</strong></td>
</tr>
<tr>
<td>• use dedicated single-patient or single-use equipment, for example blood pressure cuffs, pulse oximeters or thermometers</td>
</tr>
<tr>
<td>• implement and audit high standards of cleaning and disinfection</td>
</tr>
<tr>
<td>• decontaminate equipment after use by a colonised or infected patient, especially when the equipment may be shared with other patients</td>
</tr>
<tr>
<td>• enhance cleaning and disinfection (eg increase frequency) in response to an outbreak or cluster of CPE positive patients</td>
</tr>
<tr>
<td>• physical removal of biofilm from a sink or shower waste trap by cleaning is not recommended</td>
</tr>
<tr>
<td>• all basins, sinks and showers should be maintained so they drain efficiently</td>
</tr>
<tr>
<td>• hand wash basins should only be used for hand hygiene</td>
</tr>
</tbody>
</table>

5.1 Introduction

The environment of CPE patients has been found to be significantly contaminated (56, 66, 67). Recontamination of the environment in the presence of a patient colonised or infected with CPE can be rapid despite good standards of cleaning. No cleaning schedule can be expected to eliminate CPE reliably whilst a colonised or infected patient is present. Efforts should be focussed on containment and risk reduction; ideally equipment should be dedicated to that specific patient. If this is not possible, meticulous decontamination of any items before use with other patients is essential.
5.2 Decontamination following patient/resident discharge

Environmental decontamination is critical following the transfer, discharge or death of a colonised or infected patient and requires coordination between cleaning services, ward/unit staff and the IPC Team. Scrupulous cleaning and disinfection of all surfaces is required with particular attention to frequent hand touch surfaces. Some organisations find it helpful to use a post clean checklist before the room is used for a new patient.

The following points are examples of particular importance:
- mattresses are especially important as sheets are not an effective barrier to passage of contamination patient-to-mattress or mattress-to-patient
- bedframes, handrails and mattress covers should be cleaned then disinfected, and the integrity of the cover assessed; if the mattress cover is damaged, the mattress should be condemned. Pillows should be disposed of if the integrity of the cover is damaged or the pillow itself is soiled
- dynamic mattresses should be disassembled, cleaned and disinfected – usually by specialist external contractors or in specialist facilities within the hospital
- privacy curtains should be removed and laundered or be single-patient use only
- all used or unused single-use items or consumables in the patient’s immediate vicinity (that may have become contaminated by hand contact) should be discarded – keeping limited stocks near the patient reduces the need for this
- avoid having extraneous equipment in the individual’s room
- tubes of ointment and lubricant should be discarded
- lavatory brushes and their holder should be disposed of as part of the discharge/terminal clean

Disinfection should only be undertaken after cleaning and removal of all visible soiling. Manufacturer’s instructions should be followed. Disinfectant wipes can be used for decontaminating equipment between use (68) but can dry out if each wipe is used over too large a surface area (69).

Use a disinfectant that is effective against an Gram-negative bacteria. The choice of disinfection will depend on local considerations such as material compatibility and user acceptability. There is limited evidence on the specific use of non-contact disinfection (hydrogen peroxide dispersal or UV) as the sole intervention. If non-contact disinfection is used, conventional
environmental cleaning must occur first to remove surface physical soiling, followed by environmental disinfection.

5.3 Sinks, basins, showers and drains

Many surfaces within drainage systems will be colonised by micro-organisms in a slime layer; this is known as a “biofilm”. Antibiotic-resistant bacteria can be long-term residents within these biofilms and studies have demonstrated that hospital sinks and associated drainage systems can harbour antimicrobial resistant bacteria, including CPE (66, 70).

Sink and shower waste traps (the water filled U-bend that prevents foul air from the drain entering the indoor environment) can harbour high numbers of bacteria. Whilst most of these bacteria are firmly fixed within the biofilm matrix, bacteria can also be released into the water covering the biofilm. There is some evidence that CPE in waste traps and/or drainage biofilm can transmit to patients (66, 71, 72). Strains recovered from sinks have also been isolated from patients, but the route and/or direction of transmission is difficult to determine and is often unclear (66, 70).

This could occur in several ways:
- if the stream of water from the spout of a tap flows directly into the drain hole of the sink below, it could cause dispersal of drain water by splashing - this could contaminate surrounding surfaces and the person using that sink
- if drainage is partially blocked and water builds up in the sink bowl, there is likely to be a pooling of water and reflux from the drain - water flow from the tap will cause splashing and dispersal of contaminated water droplets
- if showers do not drain efficiently, there can be reflux of water from the drain and contact between the shower user’s feet and that contaminated water

Poor penetration and/or the inactivation of disinfectants within the biofilm matrix means well-established biofilms are highly resistant to disinfection. Whilst a variety of treatments have claimed to reduce biofilm in drainage systems, none have undergone extensive validation in more general use (62, 63).

Physical removal of biofilm from a sink or shower waste trap by cleaning is unlikely to be fully effective and any biofilm killed or removed will soon be replaced by biofilm recolonising from further down the drainage system (64, 65). Attempts at cleaning waste traps are likely to disperse profuse
contamination into the clinical area as well as contaminating the equipment used. Cleaning of waste traps should only be done whenever drainage is impaired or as planned preventative maintenance as part of a local schedule; surrounding surfaces and the equipment used should be thoroughly disinfected afterwards. Precautions to contain contamination from this should be agreed with infection control teams.

Water from tap spouts should not flow directly into the drain hole; this can still occur even if both conform to the guidance outlined in the Health Building Note (HBN 00-10 part C: Sanitary assemblies, 2013) (73). Sink design and impaired drainage have been implicated in outbreaks of multidrug-resistant bacteria, including CPE (71, 74, 75). Laboratory studies have confirmed that water flowing directly into a sink drain can disrupt established biofilm and/or cause dispersal of contaminants present within the waste trap. Allowing back flow of water from the waste trap to accumulate within the basin has been shown to facilitate dispersal of contaminated droplets (75-77).

Nutrients such as food waste may both increase bacterial numbers in a biofilm and impede drainage and should not be disposed of via sinks. Hand wash basins should only be used for hand hygiene and not for:

- disposal of body fluids
- disposal of tea, coffee or other nutrient containing beverages
- disposal of IV fluids
- washing any patient equipment
- storage of used equipment awaiting decontamination

It is important to ensure that cleaning of hand wash basins and taps is undertaken in a way that does not allow cross-contamination from a bacterial source to the tap.

5.4 Endoscopes

Transmission of multi-resistant Gram-negative bacteria, including CPE, has been observed (78, 79). All flexible endoscopes should be decontaminated in compliance with ‘Management and decontamination of flexible endoscopes (HTM 01-06)’ (80). There are no extra decontamination requirements for endoscopes used on patients who are colonised or infected with CPE, however transmission of CPE has been observed in other countries associated with duodenoscopes (78, 79). These have a more complex structure than other flexible endoscopes and consequent additional decontamination requirements which are set out on HTM 01-06.
Framework of actions to contain carbapenemase-producing Enterobacterales

Any attached cameras/equipment which cannot be steam sterilised should be protected using a single-use covering and thoroughly cleaned and disinfected between patients once the covering has been removed.
Section 6. Antimicrobial prescribing and stewardship

Box 8: New evidence and recommendations for antimicrobial prescribing and stewardship

<table>
<thead>
<tr>
<th>New evidence since publication of previous guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>• antimicrobial stewardship with particular attention to reducing the use of broad-spectrum antibiotic use is critical in the prevention of antimicrobial resistance (81)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• providers of health and social care should implement antimicrobial stewardship interventions to minimise the development of CPE</td>
</tr>
<tr>
<td>• antimicrobial resistance and consumption data should be regularly reviewed, and relevant actions taken based on findings</td>
</tr>
<tr>
<td>• treatment options must involve infection specialists including medical, nursing and pharmacy</td>
</tr>
<tr>
<td>• continuous monitoring of local antimicrobial consumption and resistance trends are critical to guide treatment and surgical prophylaxis</td>
</tr>
<tr>
<td>• antimicrobial stewardship committees should review availability of new antimicrobials through horizon scanning</td>
</tr>
</tbody>
</table>

6.1 Introduction

To minimise the development and impact of resistant Gram-negative bacteria including CPE, commissioners and providers of health and social care should regularly review their antimicrobial stewardship (AMS) programme in accordance with actions outlined in The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance criterion 3 (82), WHO Essential Medicines List adaptation (83), and recommendations specified in NICE Guidance NG15 (81) and relevant NICE/PHE Antimicrobial prescribing guidelines.

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11 Antimicrobial stewardship is defined as systems and processes for effective antimicrobial medicine use (NICE – NG 15)
6.2 General principles

Providers of health and social care should implement AMS interventions to minimise the development of resistant organisms that follow the Start Smart then Focus (84) (in secondary care) and TARGET Antibiotics resources (85) (in primary care). Antimicrobial resistance (AMR) and consumption data should be reviewed at regular intervals by local antimicrobial stewardship committees (or equivalent) and action taken where there are early signals of increasing AMR or antimicrobial consumption trends, particularly broad-spectrum agents including carbapenems, third-generation cephalosporins and piperacillin/tazobactam.

A whole system approach to AMS is important. AMS committees should consider how to have a combined approach across primary and secondary care and link with IPC committees, Sustainability and Transformation Partnerships and Integrated Care Systems to offer a one system approach. Appendix H details further resources.

6.3 Monitoring

A program of audit and quality improvement programmes to address inappropriate broad-spectrum antimicrobial prescribing with feedback to individual prescribers should be considered. Box 9 provides a range of monitoring tools available for acute and non-acute settings.

Providers should consider implementing strategies to reduce overall antimicrobial use, in particular broad-spectrum antibiotics, with efforts made to protect antibiotics in the Restrict and Watch categories (83). These strategies should also minimise use of antimicrobials associated with colonisation with CPE or other significant adverse effects (eg Clostridioides difficile infection) such as fluoroquinolones, cephalosporins and antimicrobials where high level resistance has been identified locally.

<table>
<thead>
<tr>
<th>Box 9: Monitoring tools for assessing antimicrobial usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>• NICE AMS guidance and infection guidelines assessment tools</td>
</tr>
<tr>
<td>• TARGET Toolkit audits and action planning resources on respiratory tract infections and UTI</td>
</tr>
<tr>
<td>• AMS Peer Review Inspection Tool</td>
</tr>
<tr>
<td>• Antibiotic appropriateness assessment instrument</td>
</tr>
<tr>
<td>• Point prevalence surveys</td>
</tr>
<tr>
<td>• PHE Fingertips</td>
</tr>
<tr>
<td>• ePact</td>
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<tr>
<td>• PresQipp data portals</td>
</tr>
</tbody>
</table>
6.4 Responding to increased antibiotic consumption trends

As part of responding to or identifying increased antibiotic consumption, increased frequency of monitoring is required. These may include:

- increased surveillance of CPE
- more regular review of consumption of antibiotics using the AWaRE categories (83)
- surveillance of antimicrobial resistance mechanisms driving use of carbapenems and other restricted antibiotics eg ESBL/AmpC rates

6.5 Treatment and surgical prophylaxis options

Specific and timely routine monitoring of local antimicrobial consumption and resistance trends are critical in order to guide available treatment and where appropriate surgical prophylaxis options.

Due to the varying resistance profiles and prevalence of CPE, it is not possible or appropriate to make national treatment recommendations. Treatment options must involve infection specialists including medical, nursing and pharmacy as part of the wider AMS team to ensure optimal dosing and monitoring are in place. Organisations should consider reaching out to other centres with experience in such treatment modalities.

Stewardship principles are important during surgical prophylaxis. Specifically, prophylaxis against CPE should be considered when developing local surgical prophylaxis policy:

- for patients undergoing surgery with a current systemic CPE infection or infection localised to site of surgery
- for patients colonised (including history if most recent screen negative) with CPE undergoing high risk surgery
- choice of agent for surgical prophylaxis should be based on local epidemiology or individual sensitivity results if available

6.6 ‘Horizon scanning’ for new antimicrobials

Antimicrobial stewardship committees should review the positioning and available access of new antimicrobials within the formulary through horizon scanning, particularly for antibiotics that may be required to treat multidrug-resistant Gram-negative infections.
Framework of actions to contain carbapenemase-producing Enterobacterales

Where new antibiotics with activity against CPE/multidrug-resistant bacteria are adopted for use within an organisation, a local assessment should account for:

- the impact of its routine or widespread use
- prescribing restrictions
- implementation to ensure appropriate use, with monitoring and feedback to the antimicrobial stewardship committee
Section 7. Laboratory methods

Box 10: New evidence and recommendations for laboratory methods to detect CPE

New evidence since publication of previous guidance

- detecting carbapenemase genes is important to recognise outbreaks as these genes spread horizontally (46, 47)
- identification of acquired carbapenemases can help inform treatment (86-89)

Key recommendations

- laboratories should ensure they have methods in place to detect both CPE colonisation and invasive infections using relevant PHE guidance\(^\text{12}\)
- diagnostic laboratories should implement a molecular or immunochromatographic assay for at least the detection of KPC, OXA-48-like, NDM and VIM carbapenemase families
- diagnostic laboratories should optimise and review their phenotypic laboratory methods for detection of acquired carbapenemase-producing Gram-negative bacteria

7.1 Introduction

Carbapenemases are intrinsic (found naturally) in a few clinical bacteria; this section focusses on acquired carbapenemases. Local testing for acquired carbapenemases with rapid turnaround, rather than referral to the national reference laboratory, will have maximal impact on patient management to prevent onward transmission and effective clinical treatment. However, there is currently no ‘gold standard’ methodology for detection of all carbapenemases but there are a growing number of methods available.

7.2 Detection of CPE in diagnostic laboratories

PHE strongly recommends that diagnostic laboratories implement a molecular or immunochromatographic assay for at least the detection of KPC, OXA-48-like, NDM and VIM carbapenemase families, the most commonly reported nationally and globally (90), and refer to AMRHAI all

Framework of actions to contain carbapenemase-producing Enterobacterales

carbapenem resistant isolates with local negative tests for the ‘big 4’ to detect other rarer carbapenemase families.

A screening algorithm using either a one-step detection via molecular or immunochromatographic test direct from clinical or screening specimens\(^{13}\), or two-step detection involving culture followed by molecular or immunochromatographic test should be implemented. Laboratories need to consider their local CPE epidemiology and laboratory capacity (39) when deciding on this algorithm, noting that in endemic settings a one-step approach may be more effective in rapidly detecting colonised patients and reducing transmission (26, 39)

Where possible, specimens that undergo one-step detection should also be cultured; CPE negative isolates may require further characterisation to determine whether referral to AMRHI is warranted to screen for rarer carbapenemases, whilst CPE positive specimens may require culture for organism identification, typing and determination of the antibiogram, particularly in situations where patient cohorting is being considered.

PHE’s report *Commercial assays for the detection of acquired carbapenemases* has been published to enable an informed decision on the choice of commercial carbapenemase detection assay to implement based on their local circumstances (91). Furthermore, laboratories should be referring to the most recently published UK Standards for Microbiological Investigation (SMI) *Detection of bacteria with carbapenem-hydrolysing β-lactamases (carbapenemases)* (92) to optimise phenotypic laboratory methods for detection of acquired carbapenemase-producing Gram-negative bacteria.

\(^{13}\) Note: protocols for CPE detection via immunochromatographic test direct from rectal swabs have been published but have not yet been validated by the manufacturers.
Section 8. Managing CPE outbreaks and clusters

Box 11: New evidence and recommendations for preventing and controlling CPE outbreaks

<table>
<thead>
<tr>
<th>New evidence since publication of previous guidance</th>
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<tr>
<td>• the management of individual patients with CPE and outbreaks of CPE is costly (8)</td>
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<table>
<thead>
<tr>
<th>Key recommendations</th>
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<tr>
<td>• identify the type of patients and/or setting(s) affected</td>
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<td>• adopt a screening strategy appropriate to the situation, with the aim of identifying potential cases</td>
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<td>• optimise staff-to-patient ratios and monitor adherence to IPC guidance</td>
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<td>• risk assess the need for patient isolation and/or cohorting</td>
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<td>• investigate environmental reservoirs if this is indicated or appropriate.</td>
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<td>• Review antimicrobial prescribing practices</td>
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<td>• ensure the multi-disciplinary team responding to the outbreak comprises individuals with experience of outbreak management</td>
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<tr>
<td>• undertake epidemiological assessment in an attempt to identify the source and/or assess the effectiveness of interventions</td>
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<tr>
<td>• implement a communication plan for both internal and external stakeholders</td>
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8.1 Introduction

Large-scale, costly CPE outbreaks often arise from transmission from patients whose colonisation status are not recognised or swiftly contained. It is vital that any CPE detection is appropriately managed to prevent onward transmission. A robust, multidisciplinary approach is required to investigate and manage such incidents.

Detail on the management of CPE outbreaks in acute healthcare settings has been published (93) and suggested actions are summarised in Appendix I. These aspects should be integrated into relevant organisational outbreak and multidrug-resistant organism management policies. Many of the actions may be necessary on the identification of one CPE positive patient to prevent the development of an outbreak.

While some CPE incidents are just one organism strain (clonal), others may not be organism specific – multiple different organisms may be found,
harbouring the same resistance mechanism and therefore still be linked. Microbiological expertise will be required to consider if plasmids carrying resistance mechanisms have transmitted between genera eg from *E. coli* to *Klebsiella spp.*

8.2 Risk assessment in non-acute settings

Where suspected transmission occurs in non-acute settings such as rehabilitation units or care homes, contact your local Health Protection Team or Consultant in Public Health Infection (who is located with the local Field Service Team) for help with conducting a risk assessment.

8.3 Ongoing transmission

For ongoing transmission, consider obtaining further advice from Public Health England. This could include a peer-review visit, advice or investigation from your local Health Protection Team, with additional support provided by Field Service or the national HCAI & AMR Division. PHE HPTs can liaise with Local Authority Health Protection Team/Community Infection Prevention and Control Team where these exist.
Section 9. Organisational responsibilities

Box 12: New evidence and recommendations for ensuring appropriate organisational responsibilities

<table>
<thead>
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<th>New evidence since publication of previous guidance</th>
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<tr>
<td>• communication to patients, within organisations, and between organisations is essential (21, 94-96)</td>
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</table>

Key recommendations

In acute care settings, or others where higher levels of interventional care are provided eg long-term ventilation:

• ensure the appropriate management and governance arrangements (including at board level) are in place, with CPE included in the IPC assurance framework (65)
• develop and implement a CPE prevention and control policy within each organisation and present data to the board at least bi-annually
• ensure that the Director of Infection Prevention and Control or IPC lead (as outlined in the Code of Practice) has the authority to challenge inappropriate practice and inappropriate prescribing decisions (82)
• communicate patient’s CPE status to receiving organisation or team on discharge

In all settings:

• ensure all relevant staff have received appropriate education and training on the organisation’s CPE and/or multidrug-resistant organism policy (33, 97)

9.1 Introduction

Providers of health and social care in England must have appropriate arrangements and resources in place for prevention and control of infections (82). IPC and outbreak response roles and responsibilities need to be formally assigned in all providers of regulated activities (98). These arrangements need to be proportionate to the size and complexity of the organisation, but should be appropriately communicated and adopted in any setting (99).

9.2 Leadership, planning and implementation

Leadership is essential to ensure that IPC policies are developed, communicated, and implemented, with appropriate levels of resourcing.
Commitment and coordination, along with robust planning and preparation will ensure all staff are enabled to deliver care in a way that protects patients from the risk of colonisation or infection with CPE (100). Maintaining awareness of CPE amongst staff can be a challenge to implementation, particularly for providers with no or low numbers of CPE cases (1).

9.3 Communication

The provider organisation should discharge its duty of care by ensuring that the right people, in the right place, have the right knowledge through planning early communications and this should include the following:

- alert neighbouring trusts, commissioners, providers and the local Health Protection Team about CPE outbreaks
- ensure discharge letters detail CPE colonisation and/or infection status, or potential exposure to CPE in a ward environment. This information should be received by GPs, receiving organisations and relevant healthcare professions eg district nursing teams, where appropriate (see Appendix J for primary care quick reference guide).
- communicate with the patient/family/carers (see Appendix K and Appendix L) and/or the care facility to which the patient is to be discharged, providing an accurate explanation of risk in a non-acute/community setting and IPC advice (101)

9.4 Repatriations from abroad

The receiving hospital should inform their trust IPC team at the time of the request to enable an appropriate risk assessment to be undertaken and relevant control measures implemented on arrival (including isolation and screening).

If a complex multiple patient repatriation across multiple trusts is planned, this should be coordinated through regional or national NHS colleagues and:

- PHE’s national team (HCAI.AMRdepartment@phe.gov.uk) in hours.
- the national public health on-call service (+44 20 8200 4400) out-of-hours (including weekends)
### Glossary of terms

<table>
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<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td><strong>acute care setting</strong></td>
<td>A healthcare setting, usually a hospital, that provides short-term treatment or care for an illness, urgent medical condition, injury or surgical procedure.</td>
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<tr>
<td><strong>carbapenemases</strong></td>
<td>Enzymes (such as KPC, OXA-48-like, NDM and VIM) produced by some bacteria which cause destruction of the carbapenem antibiotics, resulting in resistance.</td>
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<tr>
<td><strong>carbapenems</strong></td>
<td>A group of powerful antibiotics, used to treat severe infections. They include meropenem, ertapenem, doripenem and imipenem.</td>
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<td><strong>close contact</strong></td>
<td>A person living in the same house; sharing the same sleeping space (room or hospital bay); or a sexual partner.</td>
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<td><strong>colonisation</strong></td>
<td>The presence of micro-organisms (such as bacteria) living harmlessly on the skin or within the bowel and causing no signs or symptoms of infection.</td>
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<td><strong>decontamination</strong></td>
<td>The processes required to remove infection risk; the elements within it are context dependent. For medical devices in the context of CPE, decontamination will be either cleaning plus disinfection or cleaning, disinfection and sterilization. For the environment in the context of CPE, it would be cleaning and disinfection of items with staff or patient contact.</td>
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<tr>
<td><strong>Enterobacterales</strong></td>
<td>A group of bacteria that usually live harmlessly in the gut of humans (and animals). They include <em>Escherichia coli</em> (<em>E. coli</em>), <em>Klebsiella</em> spp., <em>Enterobacter</em> spp.</td>
</tr>
<tr>
<td><strong>high-risk for colonisation and/or infection with CPE</strong></td>
<td>A group of bacteria that usually live harmlessly in the gut of humans (and animals). They include <em>Escherichia coli</em> (<em>E. coli</em>), <em>Klebsiella</em> spp., <em>Enterobacter</em> spp.</td>
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<td>- patients with a history of an overnight stay in hospital within the last 12 months, including abroad</td>
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<td>- patients who were previously identified as CPE positive</td>
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<td>- patients who have multiple hospital admissions or treatments eg: are dialysis dependent or have had cancer chemotherapy in last 12 months</td>
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<td></td>
<td>- epidemiological link to a known carrier of CPE</td>
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Framework of actions to contain carbapenemase-producing Enterobacterales

- patients who are admitted into augmented care/high risk units
- patients with recent exposure to broad-spectrum antibiotic courses, and in particular carbapenems, within their last or current hospital stay

<table>
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<tr>
<th>high-touch surfaces</th>
<th>Surfaces that are touched many times throughout the day by various people. High-touch surfaces include, but are not limited to: bed rails; bed frames; moveable lamps; tray table; bedside table; handles; IV poles; blood-pressure cuff.</th>
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<tbody>
<tr>
<td>infection</td>
<td>The presence of micro-organisms (such as bacteria) in the body causing adverse signs or symptoms.</td>
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<tr>
<td>laboratory confirmed case – for the purposes of this guidance</td>
<td>Recent laboratory confirmation of CPE infection/colonisation during this admission episode or confirmed at a transferring healthcare facility (UK facility only).</td>
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<tr>
<td>non-acute care setting</td>
<td>Usually applies to healthcare settings that provide non-acute care, such as in care homes and mental health trusts, also rehabilitation and palliative care services including hospices.</td>
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</table>
Framework of actions to contain carbapenemase-producing Enterobacterales

# Working group and acknowledgements

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Framework of actions to contain carbapenemase-producing Enterobacteriales

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<td>Public Health Wales</td>
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References


69. Royal College of Nursing. Wipe it out, essential practice for infection prevention and control 2012.


Appendices - Framework of actions to contain carbapenemase-producing Enterobacterales

A. International guidance comparison
B. CPE – Think RISK
C. Risk prioritisation of infection prevention and control measures, screening and isolation
D. How to conduct a CPE risk assessment in non-acute settings
E. Acute care – flow chart of infection prevention and control measures to contain CPE
F. Risk assessment tool for isolating CPE-positive patients (when isolation room capacity is limited)
G. Containing CPE in a paediatric setting
H. Antimicrobial stewardship tools and resources
I. Considerations when managing an outbreak of CPE in acute care settings
J. Primary care quick reference guide
K. Frequently asked questions that can be used in local patient information materials
L. CPE patient-held card
Appendix A: International guidance comparison

The following schematic highlights key interventions recommended across other national and international guidelines:

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<thead>
<tr>
<th></th>
<th>Hand hygiene</th>
<th>Contact precautions</th>
<th>Single room</th>
<th>Cleaning / disinfection</th>
<th>Environmental screening</th>
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<th>Active surveillance cultures</th>
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<td>Blank</td>
<td>Blue</td>
<td>Blue</td>
</tr>
</tbody>
</table>

Blue square = recommended; orange square = not recommended; Blank = not mentioned or no recommendation.

*ESCMID guidelines did not include CPE specifically, but did include recommendation for MDR K. pneumoniae, which are included here as a proxy for CPE.


References (please click on underlined text for link)

Appendix B: CPE – Think RISK

Healthcare providers should consider the risk of CPE carriage when admitting patients. Patients that meet the **RISK** criteria should be screened on admission.

| R – Recent exposure to antibiotics | Patients that have received the following antibiotics in the previous month are at increased risk of CPE carriage:  
| | • cephalosporins  
| | • piperacillin/tazobactam  
| | • fluoroquinolones  
| | • carbapenems |

| I – In the last 12 months | Screen if a patient:  
| | • previously been identified as CPE positive  
| | • was admitted to any hospital in the UK or overseas  
| | • has had multiple hospital treatments eg haemodialysis or receiving cancer chemotherapy |

| S – Specialty | Patients admitted to the following specialties should be screened:  
| | • augmented care  
| | • high-risk settings:  
| | • immunosuppression transplant  
| | • haematology/oncology organ support  
| | • extensive care needs eg liver burns unit  
| | • Long Term Care Facilities where higher levels of interventional care are provided eg long-term ventilation |

| K – Knowledge of local CPE transmission | Screen if patient has been in contact with a known case of CPE |
Appendix C: Risk prioritisation of infection prevention and control measures, screening and isolation

It is best practice for any patient receiving care who has a risk factor for colonisation with carbapenemase-producing Enterobacterales to be isolated and managed in line with the CPE framework of actions. However, where risk prioritisation is required (due to competing priorities such as side room availability) the matrix below is intended as a guide to patient placement. This is a prioritisation tool, and while the high and medium risk groups of patients are recommended to be isolated in side rooms, it is recognised this is not always possible.

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Care environment</th>
<th>Known CPE case</th>
<th>Direct transfer from hospital abroad</th>
<th>Epidemiological link</th>
<th>Hospitalisation last 12 months</th>
<th>Care dialysis/chemotherapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission to specialist/augmented unit</td>
<td>Isolate immediately in a single room with en-suite facilities (or dedicated commode or WC) and retain in isolation until screening results available</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admission to general acute ward</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Day/ambulatory care</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Outpatient clinic</td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

High risk

For the purposes of this document, the patient groups in an augmented care/high risk settings include:

- those patients who are severely immunosuppressed because of disease or treatment: this will include haematology/oncology and transplant patients and similar heavily immunosuppressed patients during high-risk periods in their therapy;
- those cared for in units where organ support is necessary, for example critical care (adult, paediatric and neonatal), renal (including dialysis settings), respiratory or other critical care or intensive care situations;
- those patients who have extensive care needs such as liver units and patients with breaches in their dermal integrity, such as in those units caring for burns.

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Care environment</th>
<th>Known CPE case</th>
<th>Direct transfer from hospital abroad</th>
<th>Epidemiological link</th>
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</tr>
</thead>
<tbody>
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<td>Admission to general acute ward</td>
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<td>**</td>
</tr>
<tr>
<td>Outpatient clinic</td>
<td>**</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Medium risk

- For outpatients and day cases – provide appointment timed for end of clinic or list; consider caring for day case in single room dependent on degree of contact with body fluids eg endoscopic procedures would pose greater risk of transmission than an ophthalmology patient. Maintain compliance with standard precautions and optimal environmental cleaning. In an outpatient setting, contact precautions should be instigated based on a risk assessment and in discussion with IPC team.

Low risk

- No action, other than be alert to change in risk-level in light of any further information relating to patient status. Maintain compliance with standard infection control precautions and optimal environmental cleaning.

For the purposes of this document, the patient groups in a high risk settings include:

- those patients who are severely immunosuppressed because of disease or treatment: this will include haematology/oncology and transplant patients and similar heavily immunosuppressed patients during high-risk periods in their therapy;
- those cared for in units where organ support is necessary, for example critical care (adult, paediatric and neonatal), renal (including dialysis settings), respiratory or other critical care or intensive care situations;
- those patients who have extensive care needs such as liver units and patients with breaches in their dermal integrity, such as in those units caring for burns.
**Appendix D: How to conduct a risk CPE assessment in non-acute settings**

At all risk levels ensure the following:

- **standard infection control precautions are maintained at all times**
- **effective environmental hygiene and cleaning:** prevention of faecal and environmental contamination is crucial; remain alert to episodes that risk direct transmission to others and/or environmental contamination; ensure timely and thorough cleaning
- **hygiene advice to individual and family/contacts** it is important to inform individuals and those around them to ensure they take appropriate personal hygiene measures to prevent the spread of infection, especially when using the toilet.

**Risk assessments must include consideration of the care environment,** eg nursing care setting, specialist or general-rehabilitation, haemodialysis unit, EMI, dementia care unit, community hospital or hospice, mental health trust, residential care, domiciliary care, or detention centre/prison.

**If the individual is colonised:** single room with en-suite facilities including toilet or designated commode is recommended; where a single room is not available, it is recommended that a designated toilet or commode is made available. No curtailment of communal activities is required where standard precautions and effective environmental hygiene are being maintained and there is no risk of transmission to others.

**If the individual is infected:** conduct a risk assessment with your IPC advisor and/or PHE contact to discuss possible isolation (with defined end-of-isolation criteria) consider the mental and physical health and wellbeing of the individual when deciding to isolate.

Always communicate the positive status of an individual when transferring the individual between care settings.

<table>
<thead>
<tr>
<th>Care needs</th>
<th>Guidance for risk assessment</th>
</tr>
</thead>
</table>
| **HIGH RISK**<br>For example, the individual has diarrhoea, faecal incontinence, smearing or ‘dirty protests’ discharging wound, long term ventilation, confusion/dementia, device(s) in situ, undergoing invasive procedures | - Identify if there is an immediate risk of infecting/contaminating others and the shared environment.  
- Discuss management with GP/clinician in charge, IPC nurse  
- Consider the mental and physical health and wellbeing of the individual and the level of supervision required |
| **MEDIUM RISK**<br>For example, the individual requires assistance with hygiene, mobility or physical rehabilitation | No immediate risk of infecting others identified:  
- Standard infection control precautions are maintained  
- Hygiene advice is provided to individual and family/contacts as appropriate  
- Maintain effective environmental hygiene |
| **LOW RISK**<br>For example, the individual is independent and self-caring | If unsure, contact your usual IPC advisor or PHE via the local Health Protection Team or Consultant in Public Health Infection, or local Community IPC Team where available |
Appendix E: Acute care – flow chart of infection prevention and control measures to contain CPE

Assessment of patients for CPE status

Patient is suspected or at risk of colonisation or infection
Take rectal swab - use culture and/or molecular or immunochromatographic tests & isolate patient (with en-suite)

No known risk
Screening not required. Send routine microbiological samples as clinically indicated

Recent laboratory confirmation ie during this admission episode or confirmed at the transferring healthcare facility
Treat as positive case (see below)

CPE identified in a routine clinical sample?

Positive result

Negative result*

Can be removed from isolation (unless another reason for continuing isolation or further screening required*).

No further action

Summary of actions required
- Inform patient of result
- Ensure patient is isolated in a single room with en-suite facilities
- Ensure standard infection control precautions and contact (transmission based) precautions are used
- Communicate to relevant clinical teams, IPC team, and others as per local policies
- Flag patient notes with result
- Consider convening incident /outbreak control meeting if there is evidence of transmission
- Identify and screen contacts as indicated
- Review clinical management including use of antimicrobials and devices (whether required)
- Communicate patient’s positive status to GP and other health/care providers on discharge/transfer

* previously positive individuals with negative screens can revert to being CPE positive, especially after a course of antibiotics – careful risk assessment is required if removing from isolation

Appendix F: Risk assessment tool for isolating CPE-positive patients (when isolation room capacity is limited)

<table>
<thead>
<tr>
<th>Does the patient have diarrhoea? (Type 6/7 on Bristol Stool Chart)</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse in a side room on a general ward</td>
<td>See questions below</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Is the patient...</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continent of urine and faeces?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Alert and orientated?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Independently mobile?</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

→ Consider caring for the patient in a bay on a general ward

<table>
<thead>
<tr>
<th>Is the patient...</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continent of urine and faeces?</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Alert and orientated?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Independently mobile?</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

→ Patient to be nursed in a side room on general ward (refer to Continence Nurse for additional advice regarding the management of continence, if available)

<table>
<thead>
<tr>
<th>Is the patient...</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continent of urine and faeces?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Alert and orientated?</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Independently mobile?</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

→ Take into account clinical environment and risk; consider moving patient to an alternative area if confused and unable to comply with isolation in a side room

<table>
<thead>
<tr>
<th>Is the patient...</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continent of urine and faeces?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Alert and orientated?</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Independently mobile?</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

→ Patient can be nursed in a bay on a general ward with a dedicated commode
Appendix G: Containing CPE in a paediatric setting

Advice from Infection Prevention and Control team

Seek advice from your IPC team, to assist with conducting a risk assessment appropriate for your environment/hospital.

There are several considerations – the key one being that the parent(s) are also likely to be colonised with a CPE and therefore, ensure the baby (with resident mother) is placed in a room with an en-suite – for the mother, and their visitors to use. If an en-suite is not available, consider a dedicated toilet.

Food management

Food brought in from home is also a potential source of cross contamination of shared fridges. Food brought in by the family should be in wipe-able containers, this need to be wiped clean prior to placing in/back into the fridge. Containers or food that has come into the patient’s environment should not be returned to the communal fridge.

Equipment management

The family are not to take any equipment/hospital items nappies, milk bottles, trays etc. out of the room. Equipment is only to be taken out of the room by a member of staff who will then clean according to the trust agreed protocol for this situation.

Used nappies

These should not to be taken out of the room - if weighing is required – weigh in the room. If this is not possible, they should be taken out in a nappy sack/container, by a member of the unit staff (not the parent/carer) to the sluice room and weighed, then disposed of. Cleaning of the scales plus any surfaces that the nappy, or staff member has been in contact with should then be undertaken.

Breast pumps

It is preferable for a mother to use her own pump. This can stay in the room with the mother, the expressing kit will need decontaminating, this should be carried out by a HCW if coming out of the room. If the mother does not have her own pump, a dedicated breast pump is preferable to be used for her for the length of the baby’s admission.

Management of expressed milk

- bottles should be cleaned by a HCW prior to storage in a communal fridge
- feeding bottles and equipment are disposed of in the room
• follow the local procedure for cleaning and decontamination of expressed kits, ensuring that surfaces are not left contaminated
• the mother & baby’s clothing should be taken home to launder and the family given advice on washing clothes at a high temperature
• the family should be able to use communal areas with advice on maintaining hand hygiene after handling nappies and care of the baby

If the baby has or develops loose/ diarrhoea stool or has a stoma

If the family are involved with nappy care or with this aspect of care, then they should wear an apron to protect their clothing from contamination to prevent possible spread to communal areas. They should be reminded of the importance of hand hygiene to reduce cross transmission

Education and follow up

The family and visitors must be educated in hand hygiene, fridge management; equipment management, as necessary and follow up to ensure compliance.

Management of food trays

Food trays and crockery/cutlery/water jugs are only to be removed from the room by the ward staff. If possible clean the underside of the tray/item prior to leaving the room. In the kitchen ensure that the crockery cutlery and tray are placed directly in the dishwasher. The surface in the kitchen should be cleaned after contact.

Toys and play

Toys should be dedicated for the child with CPE for the duration of their stay. Those that are not cleanable should either go home with the child or be discarded.

School age children having teaching:

• this should occur in the child’s room. Items that cannot be easily cleaned should not be used and should not be brought into the room
• education staff need to wear the same PPE as unit staff
• laptops etc can be wiped clean by the Education team after use
• sibling visitors are not to use the play room or school areas or communal play areas in the trust. Minimise visitors
Appendix H: Antimicrobial stewardship tools and resources

Please click on underlined text for link.

Antimicrobial Stewardship


Antimicrobial consumption


Carbapenem sparing strategies

Appendix I: Considerations when managing an outbreak of CPE in acute care settings

<table>
<thead>
<tr>
<th>Framework of actions to contain carbapenemase-producing Enterobacterales</th>
</tr>
</thead>
</table>

**Confirm type of patients and rapidity of detection**
- assess if high-risk setting or patient [see Appendix C]
- check for any delays in identification and isolation of cases
- identify contacts and monitor their distribution across the healthcare facilities (including non-acute settings)

**Adopt appropriate screening strategy**
- consider what screening strategy is appropriate (including frequency) to identify the exposed pool of contacts

**Optimise staff-patient ratios**
- optimise staff-patient ratios to allow good adherence with infection prevention and control activities
- minimise transfer of staff from affected unit to unaffected units

**Monitor adherence to infection prevention and control guidelines and cleaning standards**
- observe and highlight deficiencies in current IPC practice, and audit implementation
- Implement enhanced cleaning/disinfection approaches to mitigate the outbreak and ensure these are implemented rigorously and consistently

**Consider isolation and cohorting strategy**
- consider what isolation strategy is needed and implement [see Appendix E and Appendix F]
- cohorting may be appropriate where there are insufficient single rooms for individual isolation (ensure advice is sought from microbiologist)
- cohorting should not be undertaken where patients have different carbapenemases or different organisms
- there is some indirect evidence that nurse cohorting prevents further CPE transmission (28)

**Ensure appropriate use of shared patient equipment (eg blood pressure monitors, commodes)**
- ensure single use patient equipment is being used
- where equipment must be reused ensure appropriate disinfection

**Consider environmental reservoirs**
- consider environmental risk factors, shared equipment and reservoirs eg sink drains, and the inappropriate use of hand wash basins
- environmental microbiological sampling guided by microbiological advice on suitable sites and sampling methods may be considered
- review need for enhanced frequency of cleaning and/or the introduction of a disinfectant
<table>
<thead>
<tr>
<th><strong>Assess current antibiotic pressures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• consider whether prescribing formulary changes are required to minimise patient/environmental exposure to broad spectrum antibiotics, in particular carbapenems</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Ensure involvement of staff with relevant expertise</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• ensure multi-disciplinary team includes IPC staff and staff experienced in outbreak management</td>
</tr>
<tr>
<td>• agree incident action plan including communications to key staff and stakeholders – and update regularly</td>
</tr>
<tr>
<td>• consider closing the unit/ward to admissions to minimise potential for transmission to other patients and minimise patient transfers from affected unit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Undertake appropriate epidemiological assessment</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• develop definitions for cases and contacts</td>
</tr>
<tr>
<td>• describe outbreak data to determine epidemiological links and potential sources</td>
</tr>
<tr>
<td>• implement effective interventions as soon as possible</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Implement communication plan</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• implement internal and external outbreak communications plan including patients and families, staff awareness, and media</td>
</tr>
<tr>
<td>• implement regular brief reminders to staff to promote strict adherence to the outbreak/incident plan – particularly around adherence to IPC policies</td>
</tr>
</tbody>
</table>
Appendix J: Primary care quick reference guide

What are carbapenemase-producing Enterobacterales?

- enterobacterales are Gram-negative bacteria (including Escherichia coli, Klebsiella spp. and Enterobacter spp.) of which a subgroup, the Enterobacteriaceae, naturally colonise the gut of humans and animals
- they commonly cause opportunistic urinary tract, intra-abdominal and bloodstream infections
- carbapenemases are enzymes eg KPC, OXA-48, NDM and VIM, that destroy carbapenem antibiotics, thereby conferring resistance
- carbapenem antibiotics, include meropenem, ertapenem, imipenem and doripenem, which are normally reserved for serious infections caused by drug-resistant Gram-negative bacteria
- colonisation with carbapenemase-producing Enterobacterales is more common than infection; the duration of colonisation is unclear

High-risk groups ie at increased risk of being colonised or infected

- In the last 12 months has the individual:
  - been an inpatient in any hospital, UK or abroad
  - had multiple hospital treatments eg are dialysis dependant or have had cancer chemotherapy
  - had been previously identified as CPE positive (includes household and care home contacts of known cases)
  - any patient admitted to an augmented care or high-risk units
- Based on local epidemiology:
  - immunosuppression
  - previous exposure to broad-spectrum antibiotic courses, particularly carbapenems in last month
  - resident in Long Term Care Facilities, particularly where higher levels of interventional care are provided eg long-term ventilation.

What is required from primary care:

- on receipt of a positive result, inform and advise the patient (and/or family as appropriate) and care setting
- where the patient is in residential care, or hospital admission or repeat visits are likely, prompt your local infection prevention and control teams and PHE Centre / Health Protection Team to undertake risk assessment in relation to the patient and prevention of transmission if required
Framework of actions to contain carbapenemase-producing Enterobacterales

- code in notes as significant and indefinite or 1 year as Extended spectrum beta-lactamase and carbapenemase producing bacteria (organism) SCTID: 762987008
- seek advice from a local medical microbiologist for the management of infection (see below if colonised only); refer to secondary care for the management of severe infections
- communicate status to any receiving health/social care providers

Screening and early detection (only if requested)

Not routinely used in community. If required, rectal swab ensuring visible faecal material on swab (stool sample second choice); swabs from wounds and device-related sites may provide additional information if requested.

Decolonisation

Neither skin nor gut decolonisation are recommended. There is no effective equivalent of the topical suppression used to reduce shedding of MRSA in the healthcare environment. Attempts at eradication of MDR Gram-negative organisms from the gastrointestinal tract have not been successful.

Treatment of infection

If an infection is due to carbapenemase-producing Enterobacterales, discuss treatment with a microbiologist. If a patient with previous carbapenemase-producing Enterobacterales colonisation or infection presents with a suspected infection that is likely to be caused by a Gram-negative organism and requires empirical antibiotics, a microbiologist should be contacted for advice on antibiotic choice.

Infection prevention and control

In your surgery, standard infection prevention and control practices will minimise the spread of this organism. Standard precautions should be rigorously implemented at all times. Seek advice from your local IPC team or PHE centre / Health Protection Team if needed; where infection exists refer to risk assessment guidance and IPC guidelines for recommended measures to prevent the spread of infection.

Communication

Include patient carbapenemase-producing Enterobacterales status in all communications and within the patient record. It is crucial to communicate patient carbapenemase-producing Enterobacterales status during referrals.
Appendix K: explanations that can be used in local patient information materials

General

What ‘carbapenemase-producing Enterobacterales’ are

Enterobacterales are bacteria that usually live harmlessly in the gut of humans. This is called ‘colonisation’ (a person is said to be a ‘carrier’). However, if the bacteria get into the wrong place, such as the bladder or bloodstream they can cause infection.

Carbapenemase-producing Enterobacterales (abbreviated to CPE) are a type of bacteria which have become resistant to carbapenems, a group of powerful antibiotics. This resistance is helped by enzymes called carbapenemases, which are made by some strains of the bacteria and allows them to destroy carbapenem antibiotics. This means the bacteria can cause infections which are resistant to carbapenem antibiotics and many other antibiotics.

Why carbapenem resistance matters

Doctors rely on carbapenem antibiotics to successfully treat certain complicated infections when other antibiotics have failed. The spread of these resistant bacteria can cause problems to vulnerable patients in hospitals or other settings, because there are so few antibiotics available to treat the infections they cause.

CPE positive patient

How you can get this infection and what the symptoms are

This bacteria can be found, living harmlessly, in the gut of humans and so it can be difficult to say when or where you picked it up. However, there is an increased chance of picking up these bacteria if you have been a patient in a hospital abroad or in the UK that has had patients carrying the bacteria, or if you have been in contact with a carrier elsewhere.

How you will be cared for whilst in hospital

You may stay in a single room with toilet facilities or in a specific ward whilst in hospital. You may be asked to provide a number of samples, depending on your length of stay, to check if you are infected with or carrying the bacteria. The samples might include a number of swabs from certain areas, such as where the tube for your drip (if you have one) enters the skin, a rectal swab (a sample taken by inserting a swab briefly inside your bottom), and / or a stool sample.

How the spread of CPE can be prevented

Being in a single room or specific area helps to prevent spread of the bacteria. Healthcare workers will use gloves and aprons when caring for you and should wash their hands regularly. The most important measure for you to take is to wash your hands well with soap and water, especially after going to the toilet. You should avoid
touching medical devices (if you have any) such as your urinary catheter tube and your intravenous drip, particularly at the point where it is inserted into your body or skin. Visitors will be asked to wash their hands on entering and leaving the room and may be asked to wear an apron.

What happens when you go home

You may still be a carrier of CPE when you go home and quite often this will go away with time. No special measures or treatment are required at home. You should carry on as normal, maintaining good hand hygiene. If you have any concerns you may wish to contact your GP for advice.

Before you leave hospital, ask the doctor or nurse to give you a letter or card advising that you have had an infection and may still be a carrier of CPE. This will be useful for the future and it is important that you make healthcare staff aware of it. Should you or a member of your household be admitted to hospital, you should let the hospital staff know that you are, or have been a carrier of CPE and show them the letter/card.

How long a person can carry the bacteria

There is no definitive answer to how long a person may carry the bacteria. The length of time could be anything from a few days to indefinitely. Treatment with certain antibiotics (for any infection) may also affect length of carriage. Effective hygiene practices and the use of standard precautions for all individuals receiving care will minimise the transmission of carbapenemase-producing Enterobacterales.

Where to find more information

If you would like any further information please speak to a member of your care staff, who may also contact the Infection Prevention and Control Team for you. The Public Health England website is another source of information.

Non-acute settings

The risk to those being cared for in the community

Most people will be unaware that they are a carrier and, in general, the chance of developing an infection with the bacteria is low. However, immunocompromised individuals, and those receiving complex care in the community with frequent hospital admissions will be more vulnerable. These individuals are at greater risk of colonisation and potentially suffering more serious consequences should they develop an infection. Colonised individuals with devices in situ may be at greater risk of developing an infection.

While the level of risk for infected or colonised individuals is lower than in acute settings, if the levels of hygiene in the care setting are inadequate, resistant bacteria may spread among individuals who congregate together eg in a care home. This may increase the risk of the spread of infection within the care setting.
Why we advise a different approach for managing carbapenemase-producing Enterobacterales in the community than for acute trusts

Patients in an acute care setting often have multiple intensive interventions which restrict daily life and are concentrated together with many other vulnerable patients. In contrast, most individuals in the community are in their own home or another community setting. Generally, but not always, they are more likely to be more mobile and undergo fewer procedures or interventions.

Risk of spread in the community setting is low. To maintain a low level of risk, effective hygiene practices should be maintained by all, service users and staff; particularly for staff when assisting positive individuals with toileting, undertaking dressings, managing or changing urinary catheters and other devices. It is crucial that the affected individual is encouraged or assisted to practice good hand hygiene after visiting the toilet and that good infection prevention and control standards are followed in the management of diarrhoea and leaking wounds.

Why screening of individuals suspected of being a carrier is recommended for acute Trusts but not for other care settings

There is a higher risk of spread between patients in an acute setting. To manage patients effectively, acute trusts need to have a full understanding of the patient’s positive or carrier status, achieved through screening. This will allow them to plan the care for that individual and those around them in a safe and effective manner.

Staff may be at risk of taking this home to their families: how to minimise risk if you have a vulnerable relative at home.

Like any other bacteria that staff come into contact with routinely, effective hand hygiene and adherence to standard precautions, are the most effective way to prevent indirect spread to others, including family members. Staff should carry on as normal at home without any changes to their activities of daily living.

In order to alleviate their concerns, organisations should ensure that all staff have appropriate education, training and knowledge about carbapenemase-producing Enterobacterales and measures aimed at preventing their spread.

Whether staff caring for individuals colonised or infected with carbapenemase-producing Enterobacterales be screened to see if they have become a carrier themselves

Currently, there is no evidence to support screening of staff as part of routine infection prevention and control measures. Adherence to standard precautions in the workplace and effective hand hygiene at all times are the key measures to prevent spread.
Framework of actions to contain carbapenemase-producing Enterobacterales

What happens if the individual needs to go into hospital or to another care home

When transferring an affected individual to another care setting, senior staff should ensure that the destination hospital or setting has been supplied with a completed copy of the Inter-care transfer form – notification of an individual carrying or infected with a carbapenemase–producing Enterobacterales or other multidrug-resistant organism to inform the receiving facility of the individual’s positive status.

Direct verbal communication of the individual’s status to the receiving staff and the IPC team may be helpful in assisting them to make an appropriate risk assessment (as long as confidentiality requirements can be maintained). A ‘patient-held’ card (Appendix L) may be useful for the individual to present to staff if they attend another health or social care setting.

Family members or visitors who are pregnant

The placenta is an effective barrier in preventing bacteria such as carbapenemase-producing Enterobacterales from crossing from the mother to the baby, therefore the unborn baby is not at risk in the womb. The affected individual should practice effective hand hygiene, especially after visiting the toilet (as these bacteria are mainly carried in the gut) to minimise transmission of carbapenemase-producing Enterobacterales. Similarly, effective hygienic practices by those who live with and care for the individual, including adherence to standard precautions by carers are important.

The affected individual wants to know if it is safe for them to share a bed with their partner

There is a chance that the bacteria could be passed onto the partner, particularly if the affected individual has a discharging infected wound. This would need to be contained within an impermeable dressing and regular laundering of bedding encouraged. Advice can be sought about individual cases from your usual IPC advisor, the individual's GP or local PHE Centre.

Precautions required when ambulance staff transport a patient

In a similar way to transporting any patient, standard precautions should be adopted and routine cleaning of trolleys and equipment between patients undertaken. If there is any contamination from a leaking wound or faecal contamination, terminal cleaning of the vehicle will be required.

Affected individuals who have companion animals

Companion animals, for example cats, dogs and horses can become colonised or infected with carbapenemase-producing Enterobacterales. There is some evidence to suggest the transmission of carbapenemase-producing Enterobacterales from affected humans to companion animals, and rare evidence of transmission between companion animals in veterinary hospitals. Further research is required to understand the risk that colonised companion animals pose to human health. Effective hand hygiene using soap and water when handling companion animal
faeces, before handling food for companion animals and maintaining a clean environment can minimise the risk of transmission.  

Where to get further advice?  

If the advice is not relevant to your situation, please seek further advice from your usual advisor - community or CCG IPC team/nurse, medical microbiologist, the individual’s general practitioner (according to which service is appropriate and available). Alternatively, you may obtain further advice and signposting, particularly in relation to making a risk assessment, through your local PHE Centre. The Public Health England website is another source of information.
Framework of actions to contain carbapenemase-producing Enterobacterales

Appendix L: CPE patient-held card

Some trusts may provide CPE carriers with cards such as found below. This card can be cut out and folded in half to fit in a standard wallet or printed double sided at credit card size.

An evaluation on the use of these cards has been published.14

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