ARHAI Scotland
Antimicrobial Resistance and Healthcare Associated Infection

NHS National Services Scotland

Toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae in Scottish acute settings

Version Control

Version no.	Date	Page no.	Amendment Summary
1.1	July 2017	10	Clarification of inpatient inclusion criteria
1.1	July 2017	11	Reformatted algorithm- no changes to content.
1.1	July 2017	14	Footnote added re consent for swab/samples.
1.1	July 2017	16	Clarification of samples to be taken for additional screening.
1.1	July 2017	16	Line added on rescreening of repeat readmissions.
1.1	July 2017	21	Reference added for staff screening in outbreaks.
1.1	July 2017	24	Updated reference for SMVN standards.
1.1	July 2017	40	Removal of notification of SAS from inter-care transfer form.
1.2	November 2018	5	Note added about CPE uptake monitoring
1.2	November 2018	7	Reference to WHO guidance added
1.2	November 2018	12	Note added on obtaining CRA information including sources of information relating to previous positive CPE status
1.2	November 2018	21	New advice added on post-discharge contact screening
1.2	November 2018	29	Reference to NIPCM Chapter 3 added
1.2	November 2018	30	Updated link to NES HAI admission screening module
1.2	November 2018	39	Re-insertion of notification of SAS from inter-care transfer form.
1.2	November 2018	43	Addition to glossary describing hospital contact

Version no.	Date	Page no.	Amendment Summary
1.2	May 2019	34	Amendment of error under Hospital Wide section, second HIIAT corrected as HIIORT
1.3	December 2019	12	Clarification re the consideration of wider infection risk assessment undertaken at time of admission as per NIPCM (Including when previous CPE status cannot be determined from patient and/or family)
1.3	December 2019	45	Inclusion of MDRO Admission Screening CRA flowchart
1.4	June 2022		Reviewed in line with 3 yearly schedule. Reformatted in line with accessibility guidelines

List of abbreviations

ABHR	Alcohol-Based Hand Rub
AMT	Antimicrobial Management Team
CPE	Carbapenemase-producing Enterobacteriaceae
CRA	Clinical risk assessment
HIIORT	Healthcare Infection, Incident and Outbreak Reporting Template
HIIAT	Healthcare Infection Incident Assessment Tool
HPT	Health Protection Team
ICM	Infection Control Manager
ICD	Infection Control Doctor
IMT	Incident Management Team
IPCT	Infection Prevention and Control Team
NIPCM	National Infection Prevention and Control Manual
PHE	Public Health England
PPE	Personal Protective Equipment
SAPG	Scottish Antimicrobial Prescribing Group
SICPs	Standard Infection Control Precautions
SMVN	Scottish Microbiology & Virology Network
TBPs	Transmission Based Precautions

Contents

1. Aims and scope

This document provides practical advice aimed at Infection Prevention and Control Teams (IPCTs), clinicians and frontline staff on the early detection, management and control of carbapenemase-producing Enterobacteriaceae (CPE) in acute healthcare settings (including independent healthcare settings).

This toolkit has been adapted from Public Health England's (PHE) 'Acute trust toolkit for the early detection, management and control of carbapenemase-producing Enterobacteriaceae',[1] for use in Scottish acute settings, and supersedes the Scottish Interim Guidance, "Non-prescribing control measures to prevent cross-transmission of carbapenemase-producing Enterobacteriaceae",[2] published in June 2013. In addition, extensive consultation was undertaken with an expert CPE Screening Short Life Working Group who informed the adaptations to ensure the toolkit was fit for purpose in Scotland. The development of the toolkit followed the joint Chief Medical Officer (CMO)/Chief Nursing Officer (CNO)/Chief Pharmaceutical Officer (CPO) letter published in June 2013,[3] describing the emerging threat from CPE and the requirements for an acute hospital admission screening programme for CPE. In March 2017, the Chief Nursing Officer issued a new letter to reinforce the mandatory policy requirement for screening in NHS boards across Scotland.[4]

In April 2013 the Chief Nursing Officer (CNO) wrote to boards confirming compliance with MRSA CRA as a HAI Level 3 Indicator,[5] requiring boards to monitor locally, and for HPS to report the Scottish compliance figure annually. This KPI is to assess the level of uptake of MRSA CRA based screening, to ensure it is as effective as universal screening: at a minimum of 90% uptake. MRSA screening uptake has been monitored in Scotland since 2013 using a web-based data collection system.

Following consultation with the CPE Screening SLWG and approval from the NSS ARHAI programme board, the existing MRSA KPI system was redeveloped to include a CPE module. Although optimal CPE CRA uptake does not have the same evidence base as the MRSA target, this will enable local and national monitoring of the uptake of the CPE screening alongside measurement of MRSA screening uptake.

Whilst this toolkit focuses on CPE, consideration for other carbapenemase-producing organisms with demonstrable carbapenemase activity is essential. These organisms include some strains of *Pseudomonas* sp. and *Acinetobacter* sp.. The Healthcare Infection Society guidelines "Prevention and control of multi-drug-resistant Gram-negative bacteria: recommendations from

a Joint Working Party" found that that there was insufficient evidence to mandate routine admission screening of all patients for these and other multi-drug resistant Gram negative organisms, however, recommends screening for these organisms during the management of outbreaks.[6] The infection prevention and control (IPC) advice in this document will assist in the management of patients infected or colonised with other multi-drug resistant Gram negative organisms, although each species merits individual consideration.

This toolkit does not include prescribing advice for the treatment of CPE infections, but refers to guidance produced by the Scottish Antimicrobial Prescribing Group (SAPG).

The guidelines set out in this toolkit are the **minimum requirements** recommended for the early detection, management and control of CPE. Local IPCTs may choose to extend the scope of their own local policy based on local risk assessment.

2. Introduction

2.1 What are CPE?

Enterobacteriaceae are a family of Gram-negative bacteria which are part of the normal range of bacteria found in the gut of all humans and animals. However, these organisms are also some of the most common causes of opportunistic urinary tract infections, intra-abdominal infections and bloodstream infections. They include species such as *E. coli*, *Klebsiella* sp., *Proteus* sp. and *Enterobacter* sp..

Carbapenems are a valuable family of very broad-spectrum antibiotics which are normally reserved for serious infections caused by drug-resistant Gram-negative bacteria (including Enterobacteriaceae). They include meropenem, ertapenem, imipenem and doripenem.

Carbapenemase-producing Enterobacteriaceae (CPE) are a type of Enterobacteriaceae that are resistant to carbapenem antibiotics. These bacteria carry a gene for a carbapenemase enzyme that breaks down carbapenem antibiotics. There are different types of carbapenemases, of which KPC, OXA-48, NDM and VIM enzymes are currently the most common.

Infections caused by CPE are associated with high rates of morbidity and mortality and can have severe clinical consequences.[7] Treatment of these infections is increasingly difficult as these organisms are often resistant to many and sometimes all available antibiotics.[8]

2.2 Why provide this toolkit?

Over the last decade CPE have spread throughout the world and are now endemic in healthcare facilities in many countries.[9] In 2017 the World Health Organisation published Guidelines for the prevention and control of carbapenem-resistant Enterobacteriaceae, *Acinetobacter baumanni and Pseudomonas aeruginosa* in healthcare facilities, highlighting the national and international concern of the significant threat these organisms pose as an emerging cause of HAI.[10] In the UK, over the last five years, there has been a rapid increase in the incidence of infection and colonisation by multi-drug resistant carbapenemase-producing organisms.[11;12] Until recently, most cases in the UK were imported cases in people who had been in hospital abroad. However, there are already selected hospitals within regions such as

Manchester where CPE can be considered endemic. Therefore, there is a real risk that CPE could become endemic across Scottish healthcare.

A number of clusters and outbreaks have been reported in England, some of which have been contained. This provides evidence that when appropriate control measures are implemented, these clusters and outbreaks can be managed effectively.

2.3 Why does carbapenem resistance matter?

Carbapenem antibiotics are a powerful group of β-lactam (penicillin-like) antibiotics used in hospitals. Until now, they have been the antibiotics that doctors could rely upon to treat infections caused by Gram-negative bacteria when other antibiotics failed. Due to the lack of new antibiotics under development, carbapenems may be regarded as drugs that should only be used as a last resort, and a critically important group of agents whose effectiveness must be preserved. Unless action is taken now, the rapid spread of carbapenem-resistant bacteria has great potential to pose an increasing threat to public health and modern medicine as we know it.

2.4 How can CPE be detected early and spread prevented?

Advice is provided in the following chapters to assist in the early detection, prevention and control of CPE, particularly for organisations that have had little or no experience of these organisms. For organisations that already have established or recurrent problems with the spread of these organisms, there are additional actions that are required in order prevent and minimise the spread (see checklists in Sections 8.2 and 8.3). The approach recommended in this toolkit includes additional IPC measures for acute settings where the risk of spread, and its consequences, is greater than in non-acute settings.

A toolkit has been provided for non-acute care settings[13] where it is acknowledged that care cannot, nor needs to be, subjected to the same additional IPC measures.

Part A – intended for use by frontline staff in acute healthcare settings

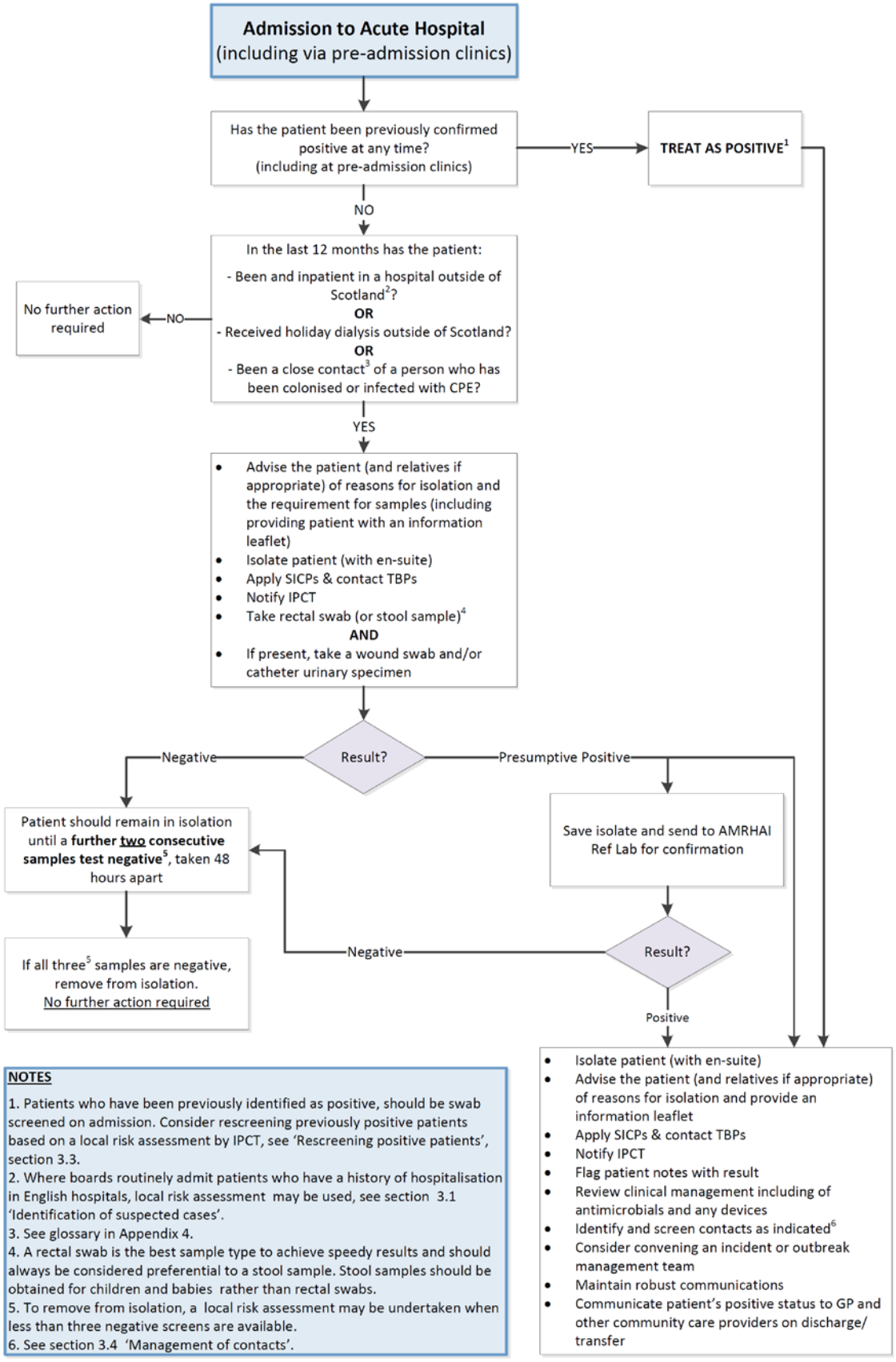
3. Identification and management of suspected and confirmed cases, and contacts.

This section of the toolkit provides guidance in the following:

- identification of suspected cases of CPE using a clinical risk assessment (CRA) (Section 3.1)
- management of suspected cases identified by the CRA (Section 3.2)
- management of confirmed cases (Section 3.3)
- management of contacts of cases (Section 3.4)

The steps to identify and manage suspected and confirmed cases of CPE are described in Figure 1. The flowchart should be applied to **all inpatients admitted to acute hospitals including paediatric, maternity/obstetrics and mental health/psychiatry patients.**

Figure 1: Patient admission flowchart: identification and management of suspected and confirmed cases of CPE.



3.1 Identification of suspected cases on admission to hospital: Clinical risk assessment (CRA)

KEY MESSAGE: Include this risk assessment as part of the routine admission procedure to identify suspected cases of CPE

CPE clinical risk assessment (CRA) allows for the early identification of patients who are colonised or are at high risk of being colonised with CPE. The risk assessment criteria set out below, and in the flowchart (Figure 1), should be included as part of routine procedures for **every admission** to identify suspected cases of colonisation (or infection) with CPE. Each patient should be assessed on admission, readmission or transfer from another healthcare facility. The application of the CPE CRA should be undertaken as part of the patient placement/assessment for infection risk, as detailed in the National Infection Prevention and Control Manual (NIPCM).[14] Once the CRA has been undertaken on admission, there is no need to repeat during the current inpatient stay in that hospital.

CRA-based screening may also be undertaken at pre-admission clinics to increase early detection of CPE positive patients prior to admission. Patients who are admitted via pre-admission clinics who are not identified as CPE positive from testing during this process should follow the normal admission screening process, including application of the CRA, at time of admission to the hospital.

Clinical risk assessment

The first step in the clinical risk assessment is to determine if the patient **has ever been previously positive for CPE**. If so, the remaining admission CRA should be bypassed and the patient immediately **managed as a confirmed case** of CPE (refer to Section 3.3 Management of Confirmed Cases). A history of CPE should be confirmed by checking systems for flags/laboratory results and by asking patients if there is no record of previous CPE status on the system. If a patient or their family are unable to confirm whether the patient has been previously positive for CPE, for example, due to language barriers, the patient should be risk assessed in the context of all other infection risks (as per the NIPCM)[14] and managed according to this risk assessment until such time as a history of CPE can be determined. As CPE is a gut organism, assessment of any loose stools and/or vomiting is of particular importance.

It is possible that patients who have been identified as CPE positive in other boards or outside of Scotland, will not be flagged on local systems on admission and confirmation from the patient will be the only method of determining previous CPE positive status.

The CRA defines a suspected case based on the identification of **at least one** the following risk factors within the 12 month period preceding admission:

1. Been an inpatient in a hospital outside of Scotland[a]
2. Received holiday dialysis outside of Scotland[a]
3. Been a close contact[b] of a person who has been colonised or infected with CPE

Any patient with a positive response to any of the CRA questions should be managed as a **suspected case** (Refer to section 3.2 Management of Suspected Cases).

An MDRO admission screening CRA flowchart is provided in Appendix 5. This document provides frontline staff with guidance to completing the CRA and the actions required based on the answers to the CRA questions. The flowchart currently includes guidance for the organisms covered by national policy (CPE and MRSA). Local teams may be screening for other MDRO or may be screening above national policy requirements and may choose to use local admission documentation to cover these additional screening activities.

[a]. Where boards routinely admit patients who have a history of hospitalisation in English hospitals, local risk assessment based on intelligence from cross-border facilities may be used to determine need for screening. In addition, boards may wish to screen transfers from within Scotland based on their own local risk assessment.

[b]. A close contact is defined as a person living in the same house; sharing the same sleeping space (room or hospital bay); or a sexual partner.

IPCTs should ensure that risk assessment takes place and it is effective by:

- Ensuring the CRA is included in routine admission and transfer documentation
- Providing training for all relevant staff in:
    - taking an effective admission history
    - recognising patients who meet the criteria for a suspected or laboratory confirmed case

- the content of the local CPE Management Plan (see Section 8.1, CPE management plan)

- Acting promptly if a suspected or laboratory-confirmed case presents on admission to hospital.

3.2 Management of suspected cases

KEY MESSAGE: If you have a suspected case of CPE this step is required to prevent spread within the hospital.

If one or more of the criteria in the CRA are met the patient should be considered a suspected case of colonisation or infection.

Note: **If the patient has ever been previously positive for CPE**, the patient should immediately be managed as a **confirmed case of CPE** (refer to Section 3.3 Management of Confirmed Cases).

Management of a suspected case

- **Patient should be immediately isolated**[a] in a single room with en-suite facilities (or designated commode if en-suite is unavailable)

- SICPs and contact TBPs should be applied as per the National Infection Prevention and Control Manual (NIPCM)[14]

- Screening sample(s) should be taken and sent for testing[b]

- Ensure that the laboratory, IPCT and relevant clinicians have been informed.

- Advise the patient (and relatives if appropriate) of reasons for isolation and the requirement for samples (including providing patient with an information leaflet[11])[c]

- Advise the patient (and relatives if appropriate) about the importance of hand hygiene and personal hygiene in preventing transmission.

[a] Consider cohorting patients with dedicated nursing team if insufficient rooms available for isolation. A local risk assessment should be undertaken before deciding to cohort patients.

[b] Consent to have swab/samples taken should be sought prior to screening. Patients are free to decline consent. If a patient is unable to give consent, hospitals should follow local policy in dealing with adults with incapacity.

[c] Healthcare worker information leaflets are also available.[15]

Obtaining a sample for testing

If a screening sample is required, the following samples are required as a minimum:

- A rectal swab, making sure faecal material is visible on the swab[a]

OR

- A stool sample (if a rectal swab is not feasible/acceptable)[b]

AND

- A wound swab and/or urine sample if the patient is catheterised

[a] A rectal swab is the best sample type to achieve speedy results and should always be considered preferential to a stool sample (with the exception of children - see below). A rectal swab is 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.[1] The swab should have visible faecal material to enable organism detection in the laboratory. A rectal swab should **not be** mistaken for a perineal swab.

[b] Stool samples should be obtained for children and babies rather than rectal swabs.

Other sample types (over and above those required as a minimum) may be sent for testing. The decision to send additional samples should be based on local risk assessment.

All samples should be sent to the laboratory as soon as possible, ensuring the sample request form is **clearly marked as a CPE screening sample.**

Acting on positive results

Should any of the screening samples test **POSITIVE** for CPE, the patient should be managed as a **confirmed case** (refer to Section 3.3 Management of Confirmed Cases).

Acting on negative results

If the screening sample result is **NEGATIVE**, the patient should remain in isolation until a further **two consecutive** samples test negative and a risk assessment has been undertaken.

These samples should be taken at least 48 hours apart

Note: In the event of an initial negative screening test, a local risk assessment may be undertaken by the IPCT to determine the need for subsequent testing of patients. If subsequent testing is considered necessary, it is recommended that the full suite of samples (rectal swab, plus wounds and catheter specimen urine where present) are taken. This risk assessment may consider the sensitivity and specificity of the tests undertaken by the local laboratory. For example, boards using molecular diagnostics may decide, following careful and individual risk assessment, that one negative sample is sufficient to remove a patient from isolation. Consideration should be given to the effectiveness of the swabbing technique and this should also be included within the local risk assessment.

Once three consecutive negative results (or local risk assessment following one negative result) are achieved, and following discussion with the IPCT, the patient can be removed from isolation with no further samples required. Should any subsequent samples test positive, the patient should be managed as a confirmed case (refer to Section 3.3 Management of Confirmed Cases).

IPCTs may wish to undertake local risk assessment of the need for ongoing CPE testing of patients with repeated readmissions to hospital and who have a history of healthcare outside of Scotland in the preceding year. IPCTs may consider the ongoing requirement for testing in those patients who have previously been screened as per protocol and deemed negative with no further exposure to risk factors for CPE.

3.3 Management of confirmed cases

KEY MESSAGE: If you have a confirmed case of CPE this step is required to prevent spread within the hospital.

If a patient **has ever tested positive for CPE** (either from a screening sample OR from a routine clinical sample during this or previous admission episodes) the patient is considered a **confirmed case** of CPE.

Management of a confirmed case

The following steps should be taken on identification of a confirmed case of CPE:

- the patient should be immediately isolated and remain in isolation for the duration of their hospital stay.
- samples should be obtained using the same protocol as described in Section 3.2- Obtaining a Sample for Testing.
- SICPs and contact TBPs should be applied as per the NIPCM.[14]
- where there are other cases of multi-drug resistant Gram-negative organisms, a CPE case should be considered as highest priority for use of a single room facility.[6] Local risk assessment to determine priorities should be undertaken by the IPCT.
- if the patient has an infection, they should be assessed for appropriate treatment (see Section 6).
- the patient, and family (as appropriate), should be informed of a positive result and the information leaflet provided.[15]
- the patient should be advised (and relatives if appropriate) about the importance of hand hygiene (especially after using the toilet) and personal hygiene in preventing transmission of infection to others.
- the patient's notes should be updated and flagged with the positive CPE result.

- information about the positive result should be included on all transfer/admission documents if the patient is moved to another healthcare setting or referred for community care (see Appendix 1).

- all relevant staff should be made aware when a suspected or recent laboratory confirmed case of CPE colonisation or infection has been identified.

- an immediate initial assessment should be undertaken to investigate the likely source or sources.

- rapid promotion of adherence to the local CPE Management Plan (Section 8.1) should take place, including the need for compliance with its recommendations.

Rescreening positive patients

An apparently cleared carbapenemase-producer can regrow to a detectable level in the gut flora of patients. A previously positive individual with subsequent negative screening results can revert to a positive state.[6]

Rescreening positive patients

- Screening of previously positive patients **should be** undertaken on admission.[6]

- Weekly screening of confirmed cases **may be** considered to maintain an understanding of the patient's current status whilst in hospital. The decision to weekly screen a previously positive patient should be based on local risk assessment by the IPCT.

- Patients who have previously been positive should always be treated as positive and managed as a confirmed case. However, in extenuating circumstances, if the patient has had 3 negative screens taken a minimum of 48 hours apart, a local risk assessment may be undertaken by the IPCT to determine whether the patient can be removed from isolation. Consideration should be given to the effectiveness of the swabbing technique and this should also be included within the local risk assessment. Extenuating circumstances may include the patient's wellbeing particularly in patients being cared for long term in acute care e.g. neuro-rehabilitation patients.

- A patient with CPE infection should not be removed from isolation.

Consistent application of SICPs is essential when managing the following:

- intravenous/peripheral line
- central venous catheter line
- urinary catheter
- ventilators
- wound and drains
- renal dialysis equipment
- enteral feeding equipment
- colostomy or ileostomy
- loose stools/diarrhoea
- any re-usable diagnostic equipment.

Note: Loose stools or diarrhoea (for any reason) increases the risk of spread of bacteria from the gut.

Should a patient who is colonised or has a CPE infection require a non-emergency diagnostic test or procedure which cannot be undertaken in the patient's room, the procedure should be planned, wherever possible, at the end of the day's list and the room cleaned in accordance with the NIPCM.[14]

Outpatients and renal dialysis patients: Similarly, known positive outpatients who require renal dialysis, or a diagnostic test or procedure, should be planned, wherever possible, at the end of the day's list and equipment cleaned as per the NIPCM. Known positive renal dialysis patients should be isolated, wherever possible.

Holiday dialysis patients: It is good practice to request the CPE status of patients from outside Scotland who attend Scottish units for holiday dialysis. Local risk assessment should be undertaken in the event of a request for a CPE positive patient to attend holiday dialysis in Scotland.

Identification of a confirmed case of CPE may require the identification of contacts for screening. Please refer to Section 3.4 Management of Contacts.

3.4 Management of contacts

KEY MESSAGE: Screening of contacts (based on likelihood of exposure) will help assess whether spread has occurred and will assist with preventing further spread within the hospital.

Provide patient leaflet[15] and obtain samples for testing as per Section 3.2, and based on the likelihood of exposure as follows:

- **Screening of patients in the same setting** is **NOT** normally required if the case was identified on admission and isolated immediately. Local risk assessment may also be undertaken to indicate if screening is necessary.
- **Screening of patient contacts of a positive case SHOULD** be undertaken if the case had spent time (or remained) in an open ward or bay with other patients before (or despite) having a positive result for CPE.
- **Screening of household contacts and healthcare staff** is **NOT** required – there is no compelling evidence to suggest that screening the household or healthcare staff to check for colonisation will provide additional benefit in controlling spread in the healthcare setting. Household contacts of CPE cases will be identified as a "suspected case" and screened for CPE if they are admitted to an acute hospital allowing the risk to be managed at that time.
- **Staff screening during outbreaks**: if staff screening is being considered as part of an outbreak investigation, HDL(2006)31 must be followed.[16]

If screening is indicated:

- It is not necessary to isolate contacts whilst awaiting screening results – cohort such contacts if possible and reiterate SICPs including hand hygiene for staff and patients
- Screen all patients in the bay (or ward, if patient has occupied more than one bay) on a weekly basis for 4 weeks after the last case was detected.

A case contact spreadsheet is provided in Appendix 2 to assist with contact screening.

Should any contact screen positive, they should be managed as **positive case** (refer to Section 3.3 Management of Confirmed Cases).

AND

SICPs and TBPs should be monitored and reinforced among clinical staff

AND

IPCT may request that the whole ward is screened PLUS discharged patients who occupied the bay (or ward, if case occupied more than one bay) at same time as the case (see Section 8.3, Management of outbreaks and clusters).

Indication for post-discharge screening

No evidence of cross-transmission on the ward:

- If no transmission is identified among the inpatient contacts (all inpatient contact screens are negative[a]); there is no need to screen any discharged contacts (implicitly risk deemed low)
    - It is recommended that these contacts are 'flagged' on patient administration systems as a CPE contact for subsequent admission screening. The patient would no longer be considered high risk as per the CRA after one year and where possible, the 'flag' should be removed.
    - It is recommended that these contacts and their GP are advised by the health board in question using local communication processes.

[a] Local risk assessment by the IPCT may be required to determine whether sufficient number of inpatient contacts have been screened in order to give assurance that no cross-transmission has occurred. IPCT may request that discharge screening is undertaken when only a small number of inpatient contacts have been screened.

Evidence of cross-transmission on the ward:

- If a transmission event is identified/confirmed among the inpatient contacts (**a single contact screen is positive**), discharged contacts should be screened (risk is considered higher due to evidence of cross transmission)

- Screening should be restricted to contacts of cases on the ward where there is evidence of cross-transmission
- Rectal/faecal screening should be undertaken (3 screens at least 48 hours apart)
- Patients should be provided with information including information leaflets about CPE screening
- It is recommended that these contacts are 'flagged' on patient administration systems as a CPE contact for subsequent admission screening as per toolkit
- Removal of 'flags': patients with 3 negative screens in the community should have the 'flag' removed
- The logistics and organisation of post-discharge screening should be a local decision based on existing systems and processes e.g. who will manage screening, who will obtains the samples, involvement of the health protection team, etc
- Household contacts of a case of CPE identified post-discharge do not require to be screening but should be advised to inform healthcare staff that they have been a contact of CPE if they are admitted to hospital.

- In extenuating circumstances, where the decision is taken not to screen contacts of cases post-discharge, a full local risk assessment should be undertaken. A record of the decision not to screen must be documented with the justification for the decision.
  - It is recommended that these contacts are 'flagged' on patient administration systems as a CPE contact for subsequent admission screening.
  - It is recommended that these contacts and their GP are advised using local communication processes.

4. Environmental cleaning and decontamination

KEY MESSAGE: CPE can be eliminated from the environment by appropriate decontamination as set out in the NIPCM.[14]

Section 2.3 Safe Management of the Care Environment of the NIPCM details routine environmental decontamination and terminal decontamination.

5. Microbiology Testing

Testing should be undertaken according to the methods currently recommended by the Scottish Microbiology and Virology Network (SMVN). Isolate referral criteria are laid out in the joint SMVN document 'Standardisation of testing for Carbapenemase-producing Organisms (CPO) in Scotland v1.0'.[17]

6. Treatment

KEY MESSAGE: Treatment of a patient with an infection caused by CPE should be acted upon under the advice of the microbiologist.

If the patient is colonised:

- no antibiotic treatment is required for colonisation
- decolonisation is NOT advised for the following reasons:
    - skin decolonisation is not advised as these bacteria generally colonise the gut rather than the skin
    - gut decolonisation (by prescribing antibiotics) is not advised as although antibiotics may provide some benefit, there is concern that their use would contribute to increasing resistance in the longer term.
- advise patient of the need for good hand hygiene, especially if they develop loose stools or diarrhoea (for any reason).

If the patient develops an infection:

- ensure treatment is started promptly
- treatment should be guided by susceptibility results and under the advice of the microbiologist.

Note: For further advice about treatment please refer to the current Scottish Antimicrobial Prescribing Group (SAPG) guidance on the treatment of CPE and other multi-resistant Gram-negative infections.[18]

7. Communications

KEY MESSAGE: Robust healthcare communications (within and between acute, non-acute/community settings) are crucial in implementing a successful concerted effort to prevent and control spread.

Commence communications as soon as the first suspected or confirmed case comes to light.

- Maintain communications within your organisation from board level down (including the local laboratory and between departments)
- Ensure the case is reported as per the Public Health (Scotland) Act 2008.
- Alert neighbouring hospitals and providers to allow them to put the necessary precautions and level of alertness in place to prevent spread
- Ensure good communication with receiving organisations **prior** to patient transfer or discharge and with all healthcare professionals along the patient pathway. This includes:
    - the family and/or care facility to which the patient is to be discharged to providing an accurate explanation of risk in a non-acute/community setting, IPC management advice and an opportunity for questions
- Carefully plan **well in advance** of the patient's movements and discharge/transfer discharge.

Communication is required between:

The patient so that they understand on discharge:

- their current status (e.g. infection cleared but may still be colonised and the need for good hand hygiene)
- should a close contact be admitted to hospital/healthcare setting for any reason, they need to inform healthcare staff of their exposure.

Internal colleagues

- the microbiologist and laboratory personnel
- the IPC team to remind ward staff (including domestic and visiting staff) of IPC measures within your CPE Management Plan (Section 8.1)
- your local Health Protection Teams.

Healthcare colleagues:

- microbiologists, IPC teams in neighbouring health boards and the community hospitals, care homes, primary care services especially the patient's GP plus any other relevant care provider along the patient pathway
- any boards where there is regular inter-board transfer from one unit to another.

External colleagues:

- Public Health Scotland
- CPE is notifiable under the Public Health (Scotland) Act 2008.

Note: There is no reason for discharge to be delayed once an infection has been resolved even if the patient is still colonised. Timely discussion between IPCT and the receiving facility will optimise patient transfer and ensure appropriate arrangements are put in place to provide safe patient care. Good communications will prevent unnecessary anxiety, misunderstanding or confusion for family, carers or healthcare facility receiving the patient.

Part B – intended for use and consideration during the planning and implementation phases at board/executive level

8 Preparedness

8.1 CPE Management Plan (template for local adaptation)

8.2 Hospital/board checklist of actions to prevent and minimise spread of CPE

8.3 Planning checklist for the management of outbreak and clusters

8. Preparedness

Section 8 provides tools to assist boards in preparedness including:

- CPE Management Plan template (Section 8.1)
- Hospital/board checklist of actions to prevent and minimise spread of CPE (Section 8.2)
- Planning checklist for the management of outbreak and clusters (Section 8.3)

Additional information to support the early recognition of potential infection incidents and to guide IPCTs in the incident management process within care settings can be found in Chapter 3- Healthcare Infection Incidents, Outbreaks and Data Exceedance, of the NIPCM.

8.1 CPE Management Plan (template for local adaptation)

The plan should include:

1. Resource and capacity arrangements

The following arrangements for resources should be considered so that they are available/in place to support the plan including:

- staff to provide capacity when the ward/bays have been closed, patients are in isolation or cohort nursing is underway or enhanced cleaning is required
- equipment to facilitate the above
- facilities to undertake patient screening including the CRA and access to a laboratory which provides timely feedback of results
- a system to flag the positive result (colonisation or infection) of CPE on the patient's record.

2. Staff training and update arrangements

Initial training and routine updates should be in place for all relevant healthcare and domestic staff to enable a **full understanding** of:

- your CPE Management Plan
- the potential threat of multi-drug resistant organisms, including CPE
- the clinical implications of such resistant organisms
- prudent antimicrobial prescribing
- effective risk assessment as part of the routine admission procedure
- the actions required if a patient is suspected of being infected or colonised by CPE
- SICPs and contact TBPs
- excellent two-way communications internally from board to ward and externally with other healthcare professionals and organisations
- being alert to the increased risk of infection or colonisation with patient transfers/admissions from outside Scotland
- maintaining staff awareness of the changing national and international picture.

An NHS Education Scotland module HAI Acute Hospital Admission Screening has been developed to train frontline staff to undertake CRA-based screening for CPE and MRSA.

3. 'Building a picture' to provide a baseline and monitor trends

To support the development and implementation of the CPE Management Plan:

- an understanding is required of the history/epidemiology of CPE and other multi-drug resistant organisms within your organisational setting(s);
- this will provide a baseline, which for most should be zero for carbapenemase-producing organisms i.e. no cases (or at least no transmission) has occurred within the organisation. This baseline will assist in speedy recognition of an emerging problem.

4. Early detection and effective infection prevention and control practices

Plans should be in place to ensure that early management of a suspected/confirmed case prevents on-going transmission to other patients/staff. This plan should cover:

- screening – patient and patient contacts
- provision of single rooms with en-suite facilities (or designated commode if no en suite)
- provision of equipment and supplies to ensure the application of SICPs and TBPs. For example: liquid soap, alcohol-based hand rub, appropriate PPE and suitable cleaning products
- patient movement – as an inpatient or on medical transfer/discharge
- communication with visitors.

5. Robust diagnostics/arrangements for laboratory services

- transport - forewarning laboratory of suspicion of CPE
- transport - rapid transportation of sample from clinical area to laboratory
- receipt of specimens - how this will be managed over a weekend/bank holiday
- processing specimens - how this will be managed over a weekend/bank holiday
- review laboratory standard operating procedures to ensure they are in line with the recommendations of the SMVN[17]
- review laboratory policies on referral to the Reference Laboratory
- reporting of results to the right people in a timely way.

6. Antimicrobial stewardship and treating infections (see Section 5)

Local policies should be in place to ensure:

- prudent use of antimicrobials
- appropriate antimicrobial choice when managing patients with CPE**.**

7. Planning for dealing with the first case or an increase in cases

Plans need to be in place to coordinate the response on recognition of a problem; the following should be included in the plans:

- internal communications
- external communications including the use of HIIAT and HAI-ORT[19]
- rapid application of CPE Management Plan
- criteria and procedure for instigating and convening an IMT – this will depend on:
    - the scale of the problem
    - whether transmission/spread has occurred in the hospital
    - the 'state of readiness' of the organisation

8. Effective communications, including discharge and medical (inter-healthcare) transfers

The hospital discharges its 'duty of care' by ensuring that the right people, in the right place, have the right knowledge through planning early communications (see Section 7):

- within the hospital
- with the laboratory
- between healthcare professionals, specialist units and neighbouring healthcare facilities – hospital and non-acute/community
- with healthcare providers **outside** of the area/region which the hospital liaises with on the patient pathway, sporadically or routinely, including other acute hospital or specialists units
- with the patient, providing leaflets and opportunity to discuss
- with the family and/or care home to which the patient is to be discharged – to provide an accurate explanation of risk in a non-acute/community setting, provide an opportunity for questions and signposting for further advice.

NOTE: communication needs to occur **prior** to the affected patient's transfer or discharge. It is essential that the transfer is carefully planned well in advance (see Section 7).

To ensure this plan can be implemented

1. Maintain or develop a robust surveillance system

- NHS Boards are required to implement Local Surveillance of Alert Organisms (including those with AMR such as CPE) as per ARHAI Guidance
- ensure risk factor data are collected in line with local and national surveillance
- microbiologists will coordinate the collection of additional risk factor data as per the SMVN approved list for the national enhanced CPO (including CPE) surveillance system
- discuss surveillance reporting outputs routinely at your IPCT and/or Infection Control Committee meetings to monitor for signs of spread
- repeat independent/sporadic cases may be a feature in some care settings e.g. admission from abroad to UK referral centres or to UK private hospitals. Keeping a running tally may be helpful.

2. Assess each case for source

To assess whether colonisation or infection could have been acquired in the hospital, consider whether the patient:

- met the criteria for a suspected case on admission (Section 3.1)
- has recent history of being an inpatient in another hospital.

If not, consider:

- whether the positive sample was collected more than 48 hours after admission (particularly if a previous pre-48 hour screen or culture was negative) **and/or** the patient has been an inpatient in your hospital recently
- undertaking **root cause analysis** for in-depth investigation; communicate rapidly to the inward transferring healthcare facility (if appropriate) if your risk assessment indicates that facility was the possible/likely source for the patient's infection or colonisation.

3. Review IPC practices especially if there is suspicion or evidence that the infection or colonisation was acquired within your organisation. A daily IPC Checklist is provided in Appendix 3.

4. Review laboratory arrangements and diagnostics.

5. Ensure an electronic system is in place for flagging the patient's CPE status; avoid acronyms that may be misconstrued by others who use different acronyms.

6. Prepare to detect and deal with an increase in cases or a **suspected cluster***:*

    - maintain effective surveillance and scrutiny of data relating to unusual isolates and trends
    - identify effective cascade methods, if one or more cases are detected, for rapid reminders of strict adherence to CPE Management Plan
    - include in plan, local arrangements for convening an IMT (see Section 8.2)

8.2 Hospital/board checklist of actions to prevent and minimise spread of CPE

Action	Number of cases (tick as appropriate)		
	0	1	>1
Board Engagement			
Board to make it a high priority to minimise spread and to support all infection prevention and control (IPC) measures.			
Prepare a dedicated management plan (Section 8.1).			
Hospital wide			
Run awareness/training campaign for staff especially, but not exclusively, medical and nursing staff.			
On admission, screen suspected cases (Section 3.2).			
Implement isolation strategy at triage/admission for suspected or recent laboratory-confirmed patients.			
Hold regular incident management team meetings to review epidemiology and IPC strategies, including root cause analyses where applicable. (Following local risk assessment, it may be determined that there is not a need for an IMT for a single case of CPE).			
Implement communication strategy; HIIAT assess and take action as per HIIAT SOP. (Following local risk assessment, it may be determined that there is not a need to complete a HIIORT for a single case of CPE).			
Ensure that any transmission becomes a top board priority, with leadership from board to ward.			
Laboratory			
Optimise and review laboratory methods to detect producers.			
Ensure laboratory standard operating procedures are in line with the recommendations of the SMVN.			
Infection prevention and control			
It is recommended that the IPCT ensure that the incident/problem is raised at board level. (Following local risk assessment, it may be determined that there is not a need to raise at board level for a single case of CPE).			
Implement the CPE Management Plan immediately, with application of SICPs and contact TBPs; affected patients should			

Action	Number of cases (tick as appropriate)		
	0	1	>1
be isolated in a single room with en-suite facilities or dedicated commode.			
Optimise care bundles and clinical practice for indwelling devices (review the need for the latter).			
Reinforce and optimise hand hygiene with soap and water or, on **visibly clean hands only**, alcohol-based hand rub as an alternative.			
Minimise spread by effective routine and terminal cleaning including all hand-contact and sanitary areas (increase frequency if evidence of spread); review procedures for effective decontamination of equipment.			
Designate cohort staffing depending on risk assessment, number of cases and feasibility.			
Ensure effective incident tracking via a robust surveillance system, with an IMT, full epidemiological investigation, maintaining line list and epidemic curve. (Following local risk assessment, it may be determined that there is not a need for an IMT for a single case of CPE).			
Ensure collection of additional risk factor data for enhanced surveillance system for each case.			
Prepare a readmission, discharge and transfer strategy for affected patients and contacts.			
Plan and facilitate adequate communication to other healthcare providers (intra- and inter-regionally).			
Screening			
Screen index case and case-contacts as per criteria; case find and isolate cases immediately; determine the extent of spread; convene an IMT if spread suspected; electronically flag affected patient(s) record.			
Instigate weekly screening of all patient contacts (as identified) in affected units/wards for a period of 4 weeks after the last case was detected; cohort contacts if possible/feasible. See section 3.4 for guidance on post-discharge screening.			
Screening of staff or household members is NOT routinely recommended as it is unlikely to provide additional benefit to control measures, whereas promotion of SICPs and contact TBPs to staff and household members will.			

8.3 Planning checklist for the management of outbreak and clusters

1 Early communications

- The infection control manager (ICM), senior infection control nurse (ICN) or infection control doctor (ICD) should alert the senior hospital management and key senior clinical/ward staff
- The ICM, ICN or ICD should report the Healthcare Infection Incident Assessment Tool[9] (HIIAT) status to ARHAI, according to the SOP.

2. Instigation of immediate control measures

- Immediately refer to your dedicated plan (Section 8.1) for the management of CPE
- Apply the advice within this toolkit to ensure all early control measures to prevent spread have been instigated

3. Convene an incident management team (IMT)

Representative from ARHAI (if appropriate/required).

Suggested members of the IMT:

- Infection control leads – clinician, nurse and manager
- Microbiologist
- Hospital executive representation
- Clinical representation and senior nurse manager
- Estates/domestic service representation
- Communications department
- Pharmacy/medicines management team
- Representative from the local HPT (if appropriate/required)
- Representative from PHS (if appropriate/required).

4. IMT review:

- Line list of cases – produce and maintain an epidemic curve (or running tally for repeat sporadic cases)
- Microbiological investigations to date – diagnostic and screening, plus results
- Epidemiological investigations to date including characterisation of time, place, person epidemiology
- Current hypothesis(es) for incident/outbreak/cluster
- Control measures to date and effectiveness, include compliance/audit history
- Antimicrobial practices and compliance with policies
- Staff training and awareness

5. IMT produce incident outbreak control plan including:

- Agreement on leadership, roles and responsibilities
- Frequency of meetings and reporting schedule (may change over time)
- Action plan for ongoing investigations and control measures (include timelines)
- Monitoring and reinforcing SICPs and TBPs
- Plans for maintaining and reinforcing cleaning schedule as described in the NIPCM[12]
- Transfer and discharge arrangements for affected patients
- Additional expert advice required
- Consideration of external expert or peer support visit in 'difficult to control' outbreaks

Communications strategy including patients, relatives, the media and additional professionals/organisations as outlined in 6, below).

6. Communications

- Inform/update IPCT and microbiologists of neighbouring hospitals or boards where there is regular inter-hospital transfer from one unit to another (where one unit is affected)
- Inform other healthcare providers/hospitals outside of the area/region that the hospital liaises with on the patient pathway, sporadically or routinely
- Maintain regular liaison with ARHAI
- Ensure no affected patient is transferred to another healthcare facility without verbal advice and an inter-healthcare transfer form being provided – this includes transfers to care homes, intermediate care or hospices (see Appendix 1)

Ensure no affected patient is discharged without receiving documentation on his/her status for future reference for other healthcare providers

Part C. Appendices

Appendix 1 Inter-care transfer form template

Notification of a patient colonised or infected with a CPE or other multidrug-resistant organism (For local adaptation: for use in conjunction with full discharge/transfer planning).

Patient/client details: (insert label if available)

Name: ……

Address:……..

……..

Date of birth: ……..

CHI: ……

Consultant: ……

Specialty: ……..

Contact no: ……

GP: ……

Contact no:……

Transferring facility (hospital, ward, care home, other)

Contact Name:……..

Contact No: ……..

Receiving facility (hospital, ward, care home, district nurse [if applicable], GP)

Contact Name: ……

Contact No:……

Diagnosis: (confirmed organism)

Infection: YES/NO

Colonisation: YES/NO

Microbiological identification (specimen results):

Specimen & Results	Specimen Type	Date	Result
Screen/diagnostic			
Confirmatory			
Other			

Treatment Information (if appropriate): (including type of medication, dose and duration)

Infection prevention & control precautions required/in place:

Other information relevant to patient's care:

Is the patient/client aware of their colonisation/infection status? YES/NO (if no, give reason)

Has ambulance service been informed? YES/NO

Has patient received information about their status? (Patient leaflet) YES / NO

Name of staff member completing form:

PRINT NAME: ……

CONTACT NUMBER: ……

Appendix 2. Case-contact spreadsheet (template for local adaptation).

Date first case identified: ……………………………………………,,

Hospital name and address: ………………………………………………………………………………………………….

………

Key contact details: ……….

Count of cases (colonised or infected) as of: __/__/__ (insert date)

Total number of presumptive (locally confirmed) cases	Total number of cases confirmed by reference laboratory	Total number (suspected and confirmed) remaining as inpatients	Total number of deaths	Comments

Case details

Case – history of being a confirmed case (colonised or infected) in last 12 months;

Contact - contact with a known case (whether colonised or infected) in last 12 months

Name	DOB/CHI	Sex	Ward/Bay/Bed space	Status- A (alive), D (dead)	Criteria for suspected case†	Number of contacts screened	Number of contacts screened positive for same strain

† In last 12 months has patient: been hospitalised outside of Scotland; received renal dialysis outside of Scotland; been a close contact (living in the same house; sharing the same sleeping space (room or hospital bay); or a sexual partner)

Appendix 3. Infection Prevention & Control checklist

Action	Date				
Patient placement					
Patient placement is prioritised in a suitable area pending investigation i.e. single room with clinical wash hand basin and en-suite facilities.					
Cohort areas are established if multiple cases of the same infection are confirmed or if single rooms are unavailable. (Patients should be separated by at least 3 feet (1m) if cohorted).					
Doors to isolation/cohort rooms/areas are closed and signage is clear (undertake a patient safety risk assessment for door closure).					
If failure to isolate, inform IPCT. Ensure all patient placement decisions and assessment of infection risk (including isolation requirements) is clearly documented in the patient notes and reviewed throughout patient stay.					
Patient placement has been reviewed.					
Hand hygiene					
All staff using correct technique for hand washing (see appendix 1 of NIPCM).					
All staff/visitors are washing hands with non-antimicrobial liquid soap and water if: • hands are visibly soiled or dirty; or • caring for a patient who also has a suspected or known gastro-intestinal infection **otherwise** using ABHR during routine care					
Personal Protective Clothing (PPE)					
Staff are wearing disposable aprons and gloves for direct care contact or when in the patients immediate care environment and changed between patients and/or following completion of a procedure or task.					
Safe Management of Care Equipment					
Single-use items are in use where possible.					

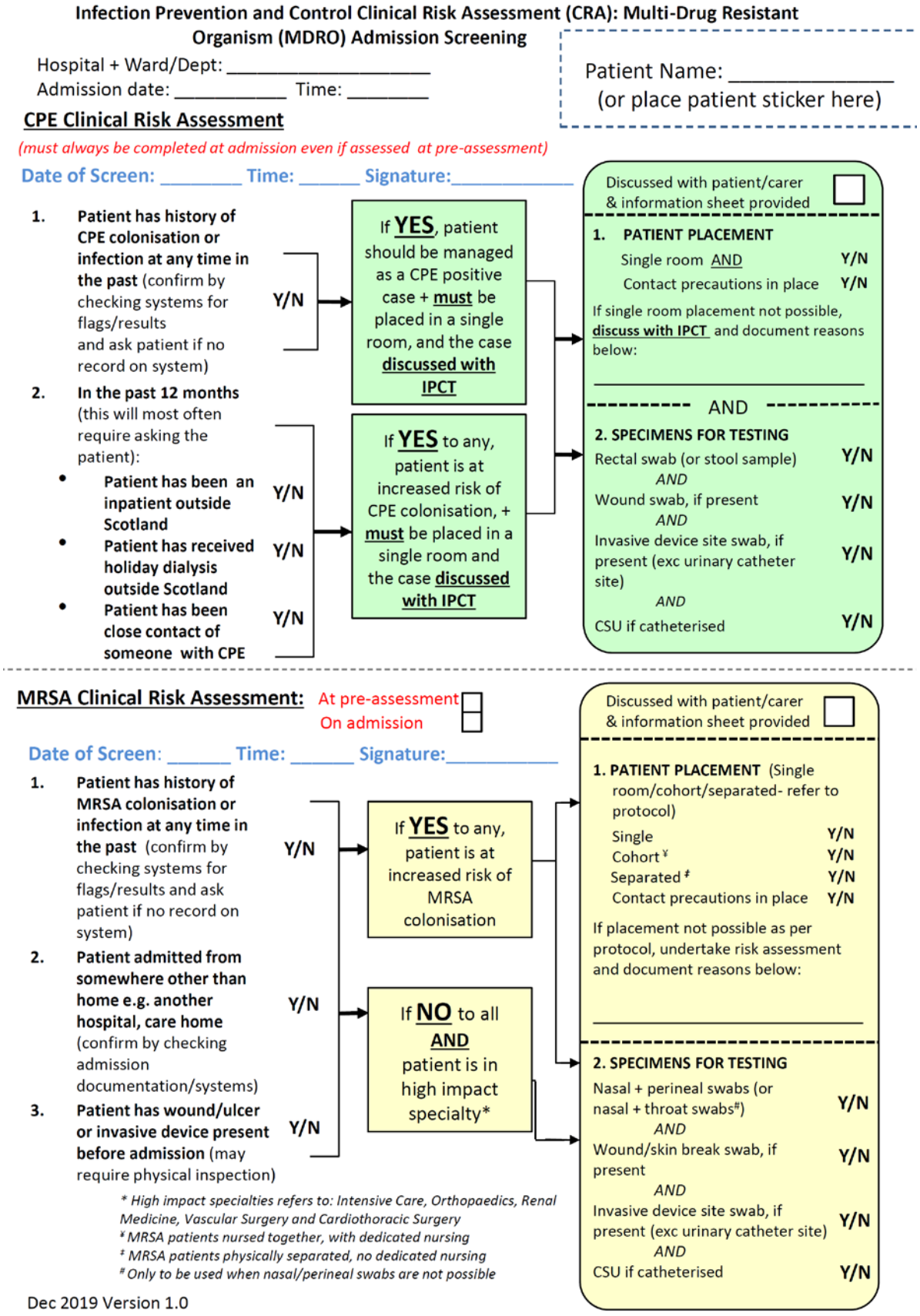
Action	Date				
Dedicated reusable non-invasive care equipment is in use and decontaminated between use and prior to use on another patient.					
Safe Management of the care environment					
All areas are free from non-essential items and equipment.					
At least daily decontamination of the patient isolation room/cohort rooms/areas is in place using a combined detergent/disinfectant solution at a dilution of 1,000 parts per million (ppm) available chlorine (av.cl.).					
Increased frequency of decontamination is incorporated into the environmental decontamination schedules for areas where there may be higher environmental contamination rates e.g. “frequently touched" surfaces such as door/toilet handles and locker tops, over bed tables and bed rails.					
Terminal decontamination is undertaken following patient transfer, discharge, or once the patient is no longer considered infectious.					
Information and treatment					
Patient informed of all screening/investigation result(s).					
Patient Information Leaflet provided and explained. (document in notes. Include family, if patient consents)					
Education given at ward level by a member of the IPCT on CPE.					
Ward staff provided with information sheet on CPE.					
Antimicrobial therapy reviewed by patient’s medical team.					

Appendix 4. Glossary of terms

Term	Description
acute care setting	Provide a wide range of specialist care and treatment for patients. Typically, services offered in the NHS Acute sector are diverse. They include: consultation with specialist clinicians (consultants, nurses, dieticians, physiotherapists and a wide range of other professionals); emergency treatment following accidents; routine, complex and life saving surgery; specialist diagnostic procedures; and close observation and short-term care of patients with worrying health symptoms.[17]
carbapenemases	Enzymes (such as KPC, OXA-48, NDM and VIM) produced by some bacteria which cause destruction of the carbapenem antibiotics, resulting in resistance.
contact (in hospital)	A person who has shared room or hospital bay with a CPE positive patient
close contact	Either a person living in the same house; sharing the same sleeping space (same room) or a sexual partner.
colonisation	The presence of micro-organisms living harmlessly on the skin or within the bowel and causing no signs or symptoms of infection.
confirmed case- for the purposes of this guidance	Patient who has ever tested positive for CPE either from a screening sample or from a routine clinical sample during this or previous admission episodes
infection	The presence of micro-organisms in the body causing adverse signs or symptoms
inpatient	Patient who is admitted to an available staffed bed in a hospital (either electively or as an emergency) and either remains overnight whatever the original intention or is expected to remain overnight but is discharged earlier.[19]
rectal swab	A rectal swab is a specimen taken by *gently* inserting a swab inside the rectum 3-4cms

Term	Description
	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 rectal swab *should not* be mistaken for a perineal swab.
suspected case- for the purposes of this guidance	A patient who, in the previous 12 months, has one or more of the following: been an inpatient in a hospital outside of Scotland; received holiday dialysis outside of Scotland; been a close contact of a person who has been colonised or infected with CPE.

Appendix 5. MDRO Admission Screening CRA flowchart



References

(1) Public Health England. Carbapenemase-producing Enterobacteriaceae: early detection, management and control toolkit for acute trusts. PHE 2013 [cited 2015 Dec 5];

(2) Health Protection Scotland. Interim Guidance: Non-prescribing control measures to prevent cross transmission of Carbapenemase-Producing Enterobacteriaceae in acute settings. HPS 2013 June [cited 2015 Oct 1];

(3) Scottish Government. Antimicrobial Resistance- CMO/SGHD(2013)14. Scottish Government; 7-8-2013

(4) Scottish Government. Carbapenemase-producing Enterobacteriaceae (CPE) policy requirement. DL(2017)04. Scottish Government 2017 March 14 [cited 2017 Mar 23];

(5) Scottish Government. MRSA Key Performance Indicators. CNO(2013)01. Scottish Government Health Department 2013 [cited 2015 Mar 23];

(6) Wilson APR, Livermore DM, Otter JA, Warren RE, Jenks P, Enoch DA, et al. Prevention and control of multi-drug-resistant Gram-negative bacteria: recommendations from a Joint Working Party. J Hosp Infect 2016 Jan;92:S1-S44.

(7) ECDC. Risk assessment on the spread of carbapenemase-producing Enterobacteriaceae (CPE) through patient transfer between healthcare facilities, with special emphasis on cross-border transfer. ECDC 2011 [cited 2015 Oct 5];

(8) World Health Organization. Antimicrobial Resistance. Global Report on Surveillance. WHO 2014 April [cited 2015 Oct 1];

(9) ECDC. Techinical Report. Carbapenemase-producing bacteria in Europe:Interim results from the European survey on carbapenemase-producing *Enterobacteriaceae* (EuSCAPE) project 2013. ECDC 2013 November 15 [cited 2015 Apr 13];

(10) World Health Organization. Guidelines for the prevention and control of carbapenem-resistant Enterobacteriaceae, *Acinetobacter baumanii* and *Pseudomnas aeruginosa* in health care facilities. WHO 2017 November

(11) Public Health England. English surveillance programme for antimicrobial utilisation and resistance (ESPAUR) 2010- 2014: report 2015. PHE 2014 October 10 [cited 2016 Jan 10];

(12) Health Protection Scotland. Healthcare Associated Infection Annual Report 2014. HPS 2015 May [cited 2016 Apr 1];

(13) Health Protection Scotland. Toolkit for managing carbapenemase-producing Enterobacteriaceae (CPE) in Scottish non-acute care settings. HPS 2017 September [cited 2018 Feb 21];

(14) Health Protection Scotland. National Infection Prevention and Control Manual. HPS 2015 [cited 2016 Apr 20];

(15) Health Protection Scotland. CPE Screening Information Leaflets. HPS 2016 May

(16) Scottish Government. Healthcare associate infection (HAI): human resources policy for staff screening during incidents and outbreaks- HDL(2006)31. 19-5-2006

(17) Scottish Microbiology and Virology Network (SMVN). Standardisation of testing for Carbapenemase Producing Organisms (CPO) in Scotland v1.0. SMVN 2017 June 7

(18) Scottish Antimicrobial Prescribing Group, Healthcare Improvement Scotland. Position Paper on Optimising Antimicrobial Prescribing in Possible or Suspected Infections Due to Multi-Drug Resistant Gram Negative Bacteria. SAPG 2016 April [cited 2018 Apr 3];

(19) Health Protection Scotland. Compendium of Healthcare Associated Infection Guidance. HPS 2016 April [cited 2016 Apr 20];