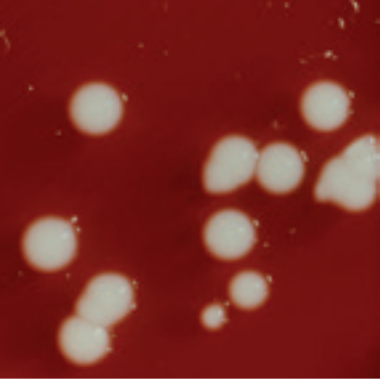
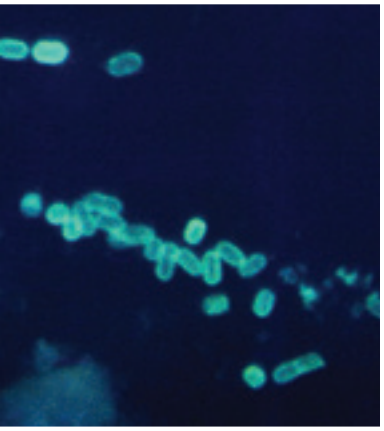
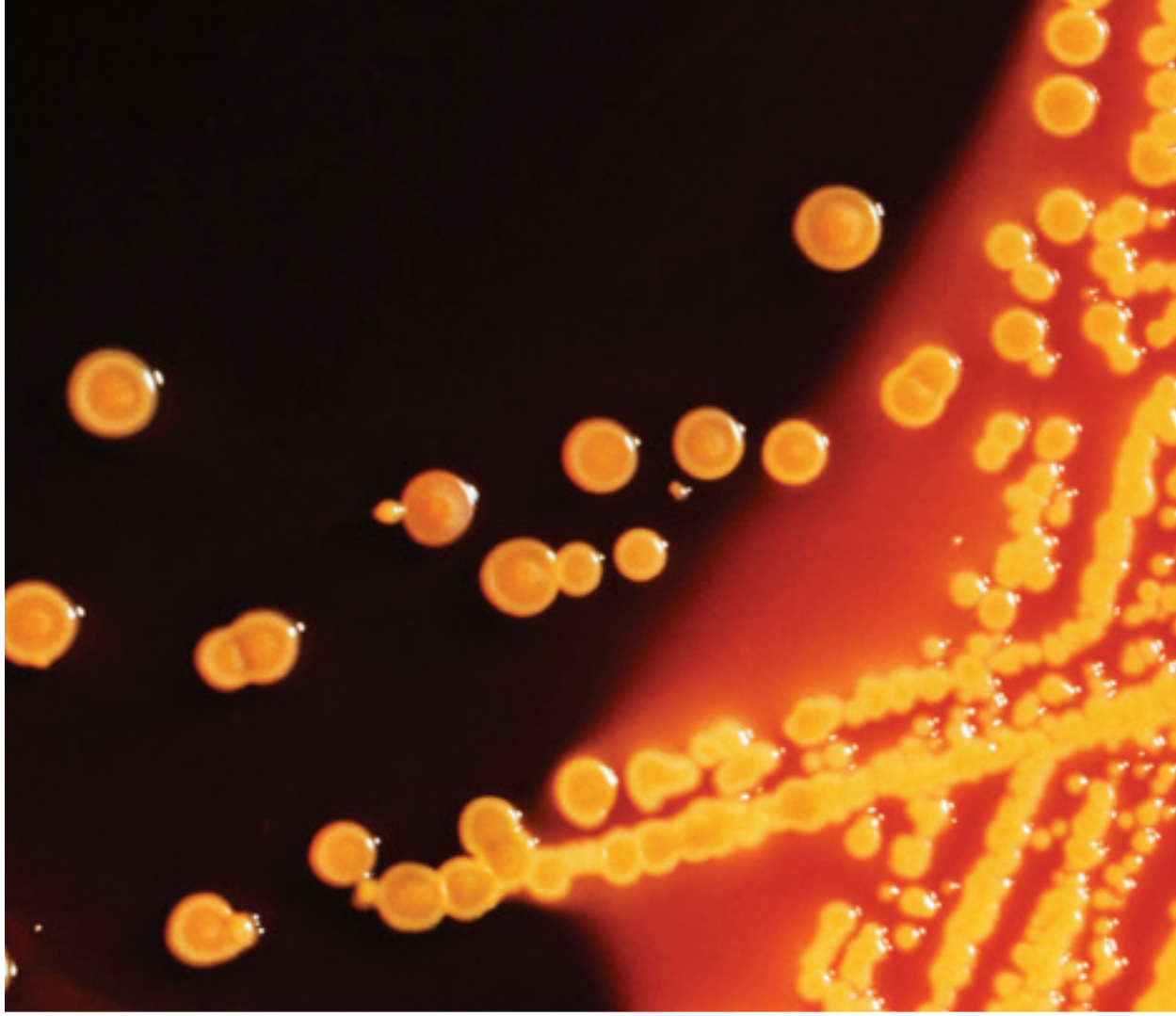






Facility Guidance for Control of Carbapenem-resistant *Enterobacteriaceae* (CRE)

November 2015 Update - CRE Toolkit

National Center for Emerging and Zoonotic Infectious Diseases
Division of Healthcare Quality Promotion

Facility Guidance for Control of Carbapenem-Resistant *Enterobacteriaceae* (CRE) November 2015 Update

This document updates CDC's Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE): 2012 CRE Toolkit. Unless otherwise specified, the term healthcare facility refers to all acute care hospitals and any long-term care facility that has patients who remain overnight and regularly require medical or nursing care (e.g., maintenance of indwelling devices, intravenous injections, wound care, etc.). This includes all long-term acute care hospitals and nursing homes providing skilled nursing or rehabilitation services, but generally excludes assisted living facilities and nursing homes that do not provide more than long-term custodial care. In addition, this toolkit is not intended for use in ambulatory care facilities.

Control of resistant organisms is a national problem and requires that facilities that share patients work together to prevent transmission. These efforts may be best coordinated by local public health. Facilities are strongly encouraged to participate in these regional efforts.

The Following Major Items Have Changed from the 2012 CRE Toolkit:

1. The CDC CRE surveillance definition has been modified.

2. The two intervention tiers have been replaced by a single tier. Not all interventions might be applicable in all settings or situations. Information is provided about situations in which specific interventions might be most important.

3. Further discussion has been added on the use of Contact Precautions in post-acute settings.

4. Information on regional interventions has been removed in order to target this document specifically to facilities. Coordinated regional approaches to prevent infections with multidrug-resistant organisms remain important; additional information on these approaches will be made available in other documents.

5. Inter-facility communication has been added to the interventions.

The emergence and dissemination of carbapenem resistance among Enterobacteriaceae in the United States represents a serious threat to public health. These organisms cause infections that are associated with high mortality rates and they have the potential to spread widely. Decreasing the impact of these organisms will require a coordinated effort involving all stakeholders including healthcare facilities and providers, public health, and industry. This document updates the 2012 CRE Toolkit and will continue to evolve as new information becomes available. The current recommended approach to control transmission of these organisms in healthcare facilities includes the following:

- Recognizing these organisms as epidemiologically important
- Quantifying the magnitude of CRE within the facility and regionally
- Identifying colonized and infected patients when present in healthcare facilities
- Implementing interventions designed to stop the transmission of these organisms

Background

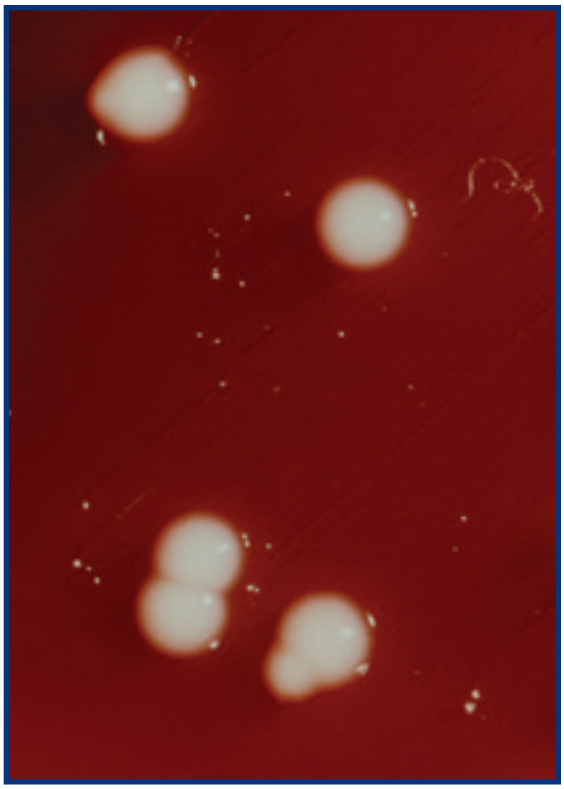
CRE are Epidemiologically Important for Several Reasons:

- Invasive infections (e.g., bloodstream infections) caused by CRE have been associated with high mortality rates (up to 40 to 50% in some studies).
- In addition to β-lactam/carbapenem resistance, CRE often carry genes that confer high levels of resistance to many other antimicrobials, often leaving very limited therapeutic options. "Pan-resistant" CRE have been reported.
- CRE have spread throughout most parts of the United States and other countries and have the potential to spread more widely.
- Currently in the United States, CRE are primarily identified among patients with healthcare exposure, but there is potential for CRE to spread outside of healthcare settings, given that Enterobacteriaceae are a common cause of community-associated infections.

Carbapenem resistance among Enterobacteriaceae can be due to several different mechanisms. Some CRE possess a β-lactamase (e.g., AmpC or extended-spectrum β-lactamase (ESBL)) which, when combined with porin mutations, can render an organism nonsusceptible

to carbapenems. Some CRE possess a carbapenemase (carbapenemase-producing CRE or CP-CRE) that directly breaks down carbapenems. Carbapenemases are often contained on mobile genetic elements that facilitate transfer of resistance among Enterobacteriaceae and other gram-negative organisms. CP-CRE were first identified in the United States from an isolate collected in 1996 and have disseminated widely since that time. All but two states (ID and ME) have reported at least one CP-CRE to the Centers for Disease Control and Prevention as of November 2015. The rapid spread of CP-CRE have made these organisms a particularly important target for prevention.

Much of the increase in CRE since 2000 has been due to the spread of CRE that produce the carbapenemase *Klebsiella pneumoniae* Carbapenemase (KPC). In addition to KPC, several other types of carbapenemases have been identified in the United States since 2009. These include the New Delhi Metallo-β-lactamase (NDM), Verona Integron-encoded Metallo-β-lactamase (VIM), Oxacillinase-48-type carbapenemases (OXA-48), and the Imipenemase (IMP) Metallo-β-lactamase. Organisms producing these non-KPC enzymes are more common in some areas of the world; in the United States, they have generally been found among patients who received medical care in countries where organisms with these carbapenemases are known to be present. Beginning in 2012, however, NDM has been increasingly reported among U.S. patients without a recent history of exposure to healthcare outside of the United States. More recently, reports of Enterobacteriaceae producing OXA-48-type enzymes have also increased in the United States.



Klebsiella pneumoniae

The current U.S. distribution of CRE (both CP-CRE and non-CP-CRE) appears to be heterogeneous; these organisms are more commonly isolated from patients in some parts of the United States, but they are not regularly found in other regions. Even in areas where CRE are found they may be more commonly present among patients in some healthcare settings, such as long-term acute care hospitals, than they are in others. Healthcare facilities should work with public health to have an awareness of their regional CRE epidemiology; understanding this information can help inform CRE prevention efforts.

Interventions to control CRE are evolving as more data and experience become available. Since these organisms currently are primarily isolated from people with healthcare exposures and the bulk of transmission appears to occur in these settings, interventions have primarily included identifying people colonized or infected with CRE while in healthcare settings and applying interventions designed to minimize the risk of transmission. The specific interventions are described in detail in the next sections. Although the interventions described in the next sections are applicable to most healthcare settings and most organisms meeting the CRE defintion, facilities may choose to target some of the interventions to certain situations (e.g., outbreaks) and certain types of CRE (e.g., CP-CRE).

CRE Definitions

In general, CRE are Enterobacteriaceae that are nonsusceptible (i.e., intermediate or resistant) to a carbapenem. However, as described above, carbapenem nonsusceptibility among Enterobacteriaceae can be acquired through several different mechanisms, with carbapenemase production currently being the most concerning resistance mechanism.

Differentiating CP-CRE from CRE that are nonsusceptible to carbapenems due to other mechanisms is complicated by a number of issues, including the wide variability in the capacity of U.S. clinical and public health laboratories to perform testing for the detection of carbapenemases. Only one test for carbapenemase production, the Modified Hodge Test (MHT), is currently widely used in U.S. laboratories. Although MHT has demonstrated good sensitivity for KPC, it has lower sensitivity for other carbapenemases, such as NDM. In addition, MHT is not specific for carbapenemase production among some genera of Enterobacteriaceae (e.g., Enterobacter). Several other methods for detecting carbapenemases have been developed, including polymerase chain reaction and the Carba NP test, but these are not currently widely used in clinical laboratories in the United States. Thus, a definition that differentiates CP-CRE from non CP-CRE based on the organism's pattern of susceptibiltiy to antimicrobials (phenotypic definition) would have utility for surveillance and prevention.

However, developing a phenotypic definition for CRE that differentiates CP-CRE from non-CP-CRE has been difficult because the antimicrobial susceptibility profiles of these two groups overlap. The CRE definition included in the 2012 CRE Toolkit (nonsusceptible to imipenem, meropenem, or doripenem and resistant to all third-generation cephalosporins tested) was designed to be more specific for CP-CRE; however, it was a complicated definition that has proven difficult to implement. Further, based on an assessment of the antibiograms of CRE isolates submitted to CDC from six U.S. metropolitan areas, that definition missed

a portion of KPC-producing CRE. In addition, that definition has the potential to miss some CRE producing OXA-48-type carbapenemases, since these isolates might remain susceptible to third generation cephalosporins and a number of OXA-48-type-producing CRE evaluated at CDC have only been resistant to one carbapenem (ertapenem).

In an attempt to simplify the CRE definition as well as further increase the ability of the definition to identify CRE that produce carbapenemases, CDC has refined the 2012 interim CRE surveillance definition:

CRE are Enterobacteriaceae that are:

- Resistant to any carbapenem antimicrobial (i.e., minimum inhibitory concentrations of ≥4 mcg/ml for doripenem, meropenem, or imipenem OR ≥2 mcg/ml for ertapenem)

  OR

- Documented to produce carbapenemase

In addition:

- For bacteria that have intrinsic imipenem nonsusceptibility (i.e., *Morganella morganii*, *Proteus* spp., *Providencia* spp.), resistance to carbapenems other than imipenem is required.

- At present, acceptable tests for detecting carbapenemases include polymerase chain reaction, MHT, Carba NP, metallo-β-lactamase testing (e.g., MBL tests or screens). As described above, the MHT does have limitations including over-calling the presence of carbapenemases among Enterobacter species and failing to identify some CRE that produce an NDM enzyme; it is included among the acceptable tests at this time because of its wide use. The number of available tests for carbapenemase is expanding; facilities using a test not included on the list above should review the test performance to ensure that it has reasonable sensitivity and specificity.

The above phenotypic definition lacks specificity for CP-CRE (i.e., CRE that do not produce a carbapenemase will often meet this definition), especially in areas where CP-CRE are rare. Therefore, to guide prevention efforts, clinical and public health laboratories with the capacity to perform carbapenem resistance mechanism testing are encouraged to test for the presence of carbapenemases. Ideally, U.S. laboratories should test for the presence of KPC, NDM, and OXA-48-type carbapenemases. However, if CRE are identified from a geographical area where other types of carbapenemases are known to be common or if the patient has relevant risk factors (e.g., travel outside the United States, exposure to non-KPC carbapenemases), then testing for other carbapenemases should be considered.

Facility-Level CRE Prevention

Surveillance

Healthcare facilities should be aware of whether or not CRE have been isolated from patients admitted to their facility. In addition, facilities should know whether or not their laboratories have the capacity to perform carbapenemase testing and CRE screening tests. If these tests are not available, facilities should identify outside laboratories that can perform this testing when needed.

Facilities should consider performing ongoing evaluations to quantify the incidence of CRE organisms from clinical specimens, such as reviewing archived laboratory results to determine the number and/or proportion of Enterobacteriaceae that are CRE over a pre-specified time period (e.g., 6 to 12 months). In addition, facilities should consider collecting information on the basic epidemiology of patients colonized or infected with these organisms in order to understand common characteristics of these individuals. This might include patient demographics, dates of admission, outcomes, medications, and common exposures (e.g., wards, surgery, procedures, transfer from other healthcare facilities, etc.)

Facility-Level Prevention Strategies

The following briefly summarizes interventions recommended to prevent CRE transmission in healthcare settings. The listed interventions might be applied differently by facilities based on the underlying epidemiology of CRE in the region including the regional prevalence, the underlying CRE resistance mechanisms found in the area, and the type of healthcare facility involved. In general, standard interventions designed to prevent the transmission of multidrug-resistant organisms (MDROs) (e.g., hand hygiene, Contact Precautions) should be implemented for most CRE (CP-CRE and non-CP-CRE). However, facilities might choose to apply a wider range of interventions for CRE they judge to be epidemiologically important, including all CP-CRE. Some non-CP-CRE might also be targeted for more extensive interventions particularly during an outbreak or if the underlying prevalence of the organism is high or increasing despite the application of baseline prevention measures. The situations where each intervention might be most useful are specified more completely in the next section. For more in-depth review of MDRO prevention, please refer to the CDC HICPAC guidelines "Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006" (http://www.cdc.gov/hicpac/mdro/mdro_toc.html).

If carbapenemase testing is not available, facilities should consider the possibility that any CRE that meets the phenotypic surveillance definition is a CP-CRE and apply the interventions, as described below, accordingly. However, facilities that have information on the epidemiology of CRE in their region might choose to tailor the

range of interventions they apply based on these data. For all MDRO control efforts, facilities should work together and with state and local health departments in order to maximize the effect of the interventions regionally.

1. Hand Hygiene

Hand hygiene is a primary part of preventing MDRO transmission. Facilities should ensure that healthcare personnel are familiar with proper hand hygiene technique as well as its rationale. Efforts should be made to promote staff ownership of hand hygiene using techniques like developing local (e.g., unit) hand hygiene champions. Further, having policies that require hand hygiene is not enough; hand hygiene adherence should be monitored and adherence rates communicated directly to front line staff. Immediate feedback should be provided to staff who miss opportunities for hand hygiene. In addition, facilities should ensure access to adequate hand hygiene stations (i.e., clean sinks and/or alcohol-based hand rubs) and ensure they are well stocked with supplies (e.g., towels, soap) and clear of clutter. Further information on hand hygiene is available at www.cdc.gov/handhygiene/. This intervention is a fundamental part of infection prevention practice and should be applied for all CRE.

2. Contact Precautions

The following two sub-sections describe the use of Contact Precautions by healthcare setting type based on the type of care provided. The third section outlines general guidance for any facility using Contact Precautions.

a. Acute Care Hospitals and High-Acuity Post-Acute Care Settings

Acute care hospitals, long-term acute care hospitals, and ventilator units of skilled nursing facilities should generally place patients who are colonized or infected with CRE on Contact Precautions. Some facilities might chose to not place some non-CP-CRE that remain susceptible to other antimicrobials on Contact Precautions. All patients with CP-CRE should be placed on Contact Precautions.

Proper Use of Contact Precautions Includes:

- Performing hand hygiene before donning a gown and gloves
- Donning gown and gloves before entering the affected patient's room
- Removing the gown and gloves and performing hand hygiene prior to exiting the affected patient's room

b. Lower-acuity Post-acute Care Settings

In lower-acuity post-acute care settings (e.g., non-ventilator units of skilled nursing facilities, rehabilitation facilities), the use of Contact Precautions is more challenging and should be guided by the potential risk

that residents will serve as a source for additional transmission based on their functional and clinical status and the type of care activity that is being performed. For example, Contact Precautions should be considered for residents colonized or infected with CRE, particularly CP-CRE, who are ventilator-dependent (even if not in a ventilator unit), are incontinent of stool that is difficult to contain, have draining secretions or draining wounds that cannot be controlled. When using Contact Precautions, healthcare personnel (HCP) should adhere to the procedures outlined in the section above. For other residents with CRE (CP-CRE or non-CP-CRE) who are able to perform hand hygiene, contain their stool and secretions, and are less dependent on HCP for their activities of daily living, use of gowns and gloves should be based on the type of care provided. This consists of using gowns and/or gloves when there is potential for exposure to their fluids or secretions or there is a risk of the healthcare provider contaminating their clothes, etc. Examples of when gowns and/or gloves might be used include the following:

- Bathing residents
- Assisting residents with toileting
- Changing residents' briefs
- Changing a wound dressing
- Manipulating patient devices (e.g., urinary catheter)

Gowns and gloves might not be needed if there is minimal potential for cross-contamination from residents or their environment (e.g., setting a tray down in the room, entering the room without contacting the resident or their immediate environment). In addition, residents with CRE at lower risk for transmission (as described above) do not need to be restricted from common gatherings in the facility (e.g., meals, group activities). Further work is needed to define the risk of contamination of HCP hands and clothing with the range of activities performed in these settings.

c. All Healthcare Facilities that Use Contact Precautions

Systems should be in place to identify patients with a history of CRE colonization or infection at admission so that they can be placed on Contact Precautions. In addition, clinical laboratories should have an established protocol for notifying clinical and/or infection prevention personnel when CRE are identified from clinical or surveillance cultures.

Evidence suggests that HCP may use PPE incorrectly resulting in contamination of their skin and/or clothes. HCP can also contaminate themselves during doffing if done incorrectly. Facilities should ensure that Contact Precautions are used correctly by HCP caring for all patients with epidemiologically important MDROs including CRE. This should include ensuring HCP are educated about the proper use and rationale for Contact Precautions and that they have the opportunity to practice donning and doffing PPE and to demonstrate competency in PPE use before patient contact. In addition, facilities should ensure that there is a process to monitor and improve HCP adherence to Contact Precautions. This might include conducting periodic surveillance on the use of Contact Precautions and providing feedback to frontline staff about these results.

Currently, there is not enough evidence to make a firm recommendation about when to discontinue use of Contact Precautions for infected or colonized patients; however, CRE colonization can be prolonged (> 6 months). If surveillance cultures are used to decide if a patient remains colonized, more than one culture should be collected to improve sensitivity. Regardless of whether surveillance cultures are performed, the presence of risk factors for ongoing carriage or ongoing CRE exposure should be considered in the decision about discontinuing Contact Precautions. One recent study found that among rectal CRE carriers, predictors of rectal CRE carriage at a future healthcare encounter included exposure to antimicrobials, admission from another healthcare facility, and less than 3 months' elapsed time since their first positive CRE test. The probability of being CRE positive at the next encounter increased to 50% if one predictor was present.

Empiric Contact Precautions, in conjunction with surveillance cultures, can be considered for patients transferred from high-risk settings pending results of screening cultures. Examples include transferred patients from hospitals in countries or areas of the United States where CP-CRE are common or patients transferred from facilities known to have outbreaks or clusters of CP-CRE colonized or infected patients.

3. Healthcare Personnel Education

HCP in all settings who care for patients with MDROs, including CRE, should be educated about preventing transmission of

these organisms. At a minimum this should education and training on the proper use of Contact Precaution. This intervention is a fundamental part of infection prevention practice and should be applied for all CRE.

4. Use of Devices

Use of devices (e.g., central venous catheters, endotracheal tubes, and urinary catheters) puts patients at risk for device-associated infections and minimizing device use is an important part of the effort to decrease the incidence of these infections. Additionally, device use has been associated with the presence of CRE. Therefore, minimizing device use in all healthcare settings should be part of the effort to decrease the prevalence of all MDROs, including CRE. In acute and long-term care settings, device use should be reviewed regularly to ensure they are still required and devices should be discontinued promptly when no longer needed. For more information on preventing device-associated infection including appropriate use of devices please see http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html and http://www.cdc.gov/hicpac/cauti/002_cauti_toc.html.

This intervention is a fundamental part of infection prevention practice and should be applied for all CRE.

5. Laboratory Notification

Laboratories should have protocols in place that facilitate the timely notification (i.e., within 4 to 6 hours) of appropriate clinical and infection prevention staff whenever CRE are identified from clinical and surveillance specimens to ensure timely implementation of control measures. This is true for both facilities with on-site laboratories and those sending cultures off-site and is applicable primarily to all CP-CRE and any non-CP-CRE that are deemed epidemiologically important by the facility.

6. Inter-facility Communication/ Identification of CRE Patients at Admission

The presence of CRE infection or colonization alone should not preclude transfer of a patient from one facility to another (e.g., acute care to long-term care). However, facilities that are transferring patients colonized or infected with CRE must notify the receiving facility of the patient's CRE status so that appropriate infection prevention measures can be promptly implemented upon the patient's arrival. Additional information that might be communicated during patient transfers include the type and plan for any invasive devices that the patient has and the duration of any ongoing antimicrobial therapy. An example of an inter-facility transfer form developed by the Utah Department of Health is available at: http://health.utah.gov/epi/diseases/HAI/resources/IC_transfer_form.pdf

In addition, facilities should have a mechanism to identify patients previously identified as colonized or infected with CRE at re-admission so that appropriate infection control precautions can be instituted.

This intervention is a fundamental part of infection prevention practice and should be applied for all CRE.

7. Antimicrobial Stewardship

Antimicrobial stewardship is another primary part of MDRO control and is applicable to both acute and long-term care settings. Although the role of this activity specifically for CRE has not been well-studied, multiple antimicrobial classes have been shown to be a risk for CRE colonization and/or infection.

As part of an antimicrobial stewardship program, facilities should work to ensure that antimicrobials are used for appropriate indications and duration and that the narrowest spectrum antimicrobial that is appropriate for the specific clinical scenario is used. To assist facilities in this effort, CDC has identified core elements that are included in successful hospital antimicrobial stewardship programs, including commitment from facility leadership to support antimicrobial stewardship activities, designation of appropriate personnel to lead the program and provide drug expertise, implementation of polices and interventions to support optimal antimicrobial use, tracking and reporting of antimicrobial use and resistance rates, and education on optimal antimicrobial prescribing practices. Detailed description of these core elements is available at http://www.cdc.gov/getsmart/healthcare/pdfs/core-elements.pdf. An accompanying checklist that hospitals can use to assess whether key policies and actions to improve antibiotic use are in place can be found at http://www.cdc.gov/getsmart/healthcare/pdfs/checklist.pdf. Both these documents and additional information on antimicrobial stewardship in healthcare settings are available at http://www.cdc.gov/getsmart/healthcare.

A similar set of resources for antibiotic stewardship implementation in nursing homes can be found at http://www.cdc.gov/longtermcare/prevention/antibiotic-stewardship.html.

8. Environmental Cleaning

While, the role of the environment in CRE transmission is not completely clear, evidence from CRE outbreaks suggests that the environment can serve as a source for transmission. In order to decrease the risk of transmission, facilities should perform daily cleaning that include areas in close proximity to the patient (e.g., bed rails, patient tray) to decrease the burden of organisms. In addition, CRE have been found in sink drains in patient rooms, raising the possibility that equipment and patient supplies could become contaminated if stored within the zone where splash or aerosolization from sinks could occur. Surfaces around sinks should be cleaned and disinfected regularly and medical equipment should not be stored in close proximity to sinks.

Once CRE patients are discharged, terminal cleaning of CRE patient rooms should be performed. Consideration should be given

to monitoring the cleaning process to ensure all surfaces are adequately cleaned and disinfected.

This intervention is a fundamental part of infection prevention practice and should be applied for all CRE.

9. Patient and Staff Cohorting

When available, patients colonized or infected with any CP-CRE or any non-CP-CRE judged to be epidemiologically important should be housed in single patient rooms. In addition, consideration should be given to cohorting patients with CRE in specific areas (e.g., units or wards), even if in single patient rooms, and to using dedicated staff (i.e., without responsibility for care of non-CRE patients) to care for them. At a minimum, dedicated staff should include the providers that provide the bulk of the patient's care (e.g., nurses, nursing assistants) but could be expanded to include other staff (e.g., respiratory therapists) particularly if there are a larger number of CRE patients or during an outbreak. The specific staff that are dedicated may vary depending on the healthcare setting. If there are an insufficient number of single rooms, preference should be given to patients at highest risk for transmission such as patients with incontinence, medical devices, or wounds with uncontrolled drainage.

This recommendation is not meant to imply that one-to-one nursing is required for all CRE patients and therefore is generally not applicable to facilities with a single CRE colonized or infected patient. This recommendation might be most applicable to CP-CRE, higher prevalence areas, and during CRE outbreaks.

10. Screening Contacts of CRE Patients

Screening is used to identify unrecognized CRE colonization as clinical cultures alone will identify only a fraction of all patients with CRE. Generally, this testing has involved stool, rectal, or peri-rectal cultures and sometimes cultures of skin sites, wounds or urine (if a urinary catheter is present). A laboratory protocol for evaluating rectal or peri-rectal swabs for CP-CRE is available at (http://www.cdc.gov/HAI/pdfs/labSettings/Klebsiella_or_Ecoli.pdf). Additional non-culture-based tests are also becoming available for use in the United States that can detect the most common carbapenemases. CRE screening includes screening epidemiologically-linked contacts of newly identified CRE patients and active surveillance cultures. The former is described in this section while the latter is discussed in the following section.

If previously unrecognized carriers of epidemiologically important CRE, including CP-CRE, are identified, screening of patient contacts should be considered to identify transmission. This intervention would be most important for CP-CRE. Those patients considered contacts may vary from setting to setting; however, they usually include roommates of the previously unrecognized CRE patient. Some facilities may also choose to screen patients who might have

shared HCP or who were present on the ward at the same time.

Point prevalence surveys might be an effective way for facilities to rapidly evaluate the prevalence of CRE in particular wards/units and is usually conducted by screening all patients present on the unit. This approach could be useful in situations where a review of clinical cultures using laboratory records identifies previously unrecognized CRE patients have been housed on certain wards/units or to rapidly evaluate for additional transmission during an outbreak. Point prevalence surveys might be done only once if few or no additional CRE colonized patients are identified or might be done serially if ongoing transmission is documented.

Experience to date suggests that point prevalence surveys have generally been less likely to identify additional CRE patients when performed in response to identification of a single CRE patient without documented transmission. In these situations, due to the time it takes for the culture results on the initial CRE patient to be finalized and for the survey to be arranged, most or all of the patients who were present on the ward at the same time as the index CRE patient have often been discharged. In these situations, screening contacts at highest risk for transmission (e.g., roommates), even if those patients have been discharged or moved to another ward, is often of higher yield. If CRE transmission is identified through initial contact screening, facilities should consider expanding screening (e.g., point prevalence survey) to determine the extent of transmission and consider conducting additional ongoing surveys to document that transmission has ceased.

11. Active Surveillance Testing

This process involves performing CRE screening of patients who might not be epidemiologically linked to known CRE patients but who meet certain pre-specified criteria. This could include everyone admitted to the facility, pre-specified high-risk patients (e.g., those admitted from long-term acute-care facilities, patients who received medical care in endemic regions), and/or patients admitted to high-risk settings (e.g., intensive care units [ICUs]). This intervention might be more useful in areas with higher CP-CRE prevalence and during CRE outbreaks. It could also be used for non-CP-CRE judged epidemiologically important by the facility. Active surveillance testing has been used in control efforts for several MDROs including CRE; however, in these studies, the exact contribution of this practice to subsequent decreases in CRE is not known.

As described above, active surveillance testing is based on the finding that clinical cultures will identify only a minority of those patients colonized with CRE; unrecognized colonized patients might not be on Contact Precautions and are a potential source for CRE transmission. Surveillance testing strategies can vary depending on facility and regional CRE

epidemiology. One approach is to focus on patients admitted with CRE risk factors including overnight stays in healthcare facilities in the last six to twelve months. Alternatively, testing could target patients admitted to high risk settings (e.g., intensive care units). This testing is generally done at admission but can also be done periodically during admission (e.g., weekly). Point prevalence surveys could also be used to perform periodic surveillance. Patients identified as positive by this surveillance testing should be treated as colonized (e.g., placed on Contact Precautions, etc.). In some situations (e.g., patients admitted from high-risk settings) patients might be placed in empiric Contact Precautions until surveillance testing is found to be negative.

Regardless of whether a larger active surveillance program is undertaken, facilities should consider performing surveillance cultures to rule out CP-CRE in patients admitted following an overnight stay within the last 6 to 12 months in a healthcare facility outside the United States or in an area within the Unites States known to have a higher prevalence of CP-CRE. If a CRE is identified from surveillance or clinical cultures from a patient with a history of an overnight hospital stay outside the United States, the isolate should be sent for mechanism testing to evaluate for the presence of carbapenemases that are not regularly found in the United States. At a minimum this should include evaluation that would detect KPC, NDM, and OXA-48-type carbapenemases. This approach can help identify patients that harbor CRE with novel mechanisms of resistance so that further spread of the organism can be prevented.

12. Chlorhexidine Bathing

Chlorhexidine (CHG) bathing has been used successfully to prevent certain types of healthcare-associated infections (e.g., bloodstream infections) and to decrease colonization with certain MDROs, primarily in ICUs. For CRE, it has been used as part of a multifaceted intervention to reduce the prevalence of CRE during an outbreak in a long-term acute care facility. Chlorhexidine bathing with 2% liquid chlorhexidine or 2% chlorhexidine-impregnated wipes has been used to bathe patients (usually daily) while in high-risk settings (e.g., ICUs). The chlorhexidine is usually not used above the jaw line or on open wounds. When chlorhexidine bathing is used for a particular patient population or in a particular setting, it is usually applied to all patients regardless of CRE colonization status. Some studies suggest that CHG bathing might not always be done correctly resulting in suboptimal levels of chlorhexidine on the skin. If used, facilities should ensure that it is done correctly to ensure maximal effect.

In long-term care settings this type of an intervention might be used on targeted high-risk residents (e.g., residents that are totally dependent upon healthcare personnel for activities of daily living, are ventilator-dependent, are incontinent of stool, or have wounds whose drainage is difficult to control) or high-risk settings (e.g., ventilator unit).

This intervention is likely most important as part of a plan to control CP-CRE in areas of higher prevalence including during outbreaks. It could be used for non-CP-CRE judged epidemiologically important by the facility.

Summary

A summary of CRE prevention measures is included below.

An approach to the evaluation of newly recognized CRE colonized or infected patients is shown in Figure 1.

Summary of Prevention Strategies For Acute and Long-Term Care Facilities

Please see text for details.

1. Hand Hygiene
    - Promote hand hygiene
    - Monitor hand hygiene adherence and provide feedback
    - Ensure access to hand hygiene stations

2. Contact Precautions (CP)
    - Educate and train healthcare personnel about CP including allowing time to practice donning and doffing
    - Monitor CP adherence and provide feedback
    - No recommendations for discontinuation of CP

Acute Care

- Place CRE colonized or infected patients on Contact Precautions (CP)
    - Empiric CP might be used for patients transferred from high-risk settings

Long-term Care

- Place CRE colonized or infected residents that are high-risk for transmission on CP (as described in text); for patients at lower risk for transmission use precautions based on type of care provided

3. Healthcare Personnel Education
4. Minimize Use of Invasive Devices
5. Timely Notification from Laboratory When CRE are Identified
6. Communication of CRE Status for Infected and Colonized Patients at Discharge and Transfer
    - Identify known CRE patients at re-admission
7. Promotion of Antimicrobial Stewardship
8. Environmental Cleaning
9. Patient and Staff Cohorting
    - When available cohort CRE colonized or infected patients and the staff that care for them even if patients are housed in single rooms
    - If the number of single patient rooms is limited, reserve these rooms for patients with highest risk for transmission (e.g., incontinence)
10. Screening Contacts of CRE Patients
    - Screen patient with epidemiologic links to unrecognized CRE colonized or infected patients
11. Active Surveillance Testing
    - Screen high-risk patients at admission or at admission and periodically during their facility stay for CRE. Empiric CP can be considered while results of admission surveillance testing are pending
12. Chlorhexidine Bathing
    - Bathe patients with 2% chlorhexidine

Figure 1: Facility Approach to Evaluation of Newly Recognized CP-CRE Colonized or Infected Patients

New CRE-colonized or CRE-infected patient identified

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- Notify appropriate personnel (i.e., clinical staff, infection prevention staff)
- Notify public health (if required)

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- Place patient on Contact Precautions in single room (if available)-see discussion about use in long-term care
- Reinforce hand hygiene and use of Contact Precautions on affected ward/unit
- Educate healthcare personnel caring for patient about preventing CRE transmission

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- Consider screening epidemiologically-linked patient contacts (e.g., roommates) for CRE with at least stool, rectal, or peri-rectal cultures; consider review of microbiology records to identify previous cases
- Consider point prevalence survey of affected unit particularly if more than one CRE patient identified

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- If screening cultures or further clinical cultures identify additional CRE-colonized or -infected patients, consider additional surveillance cultures of contacts or ongoing point prevalence surveys of affected units until no further transmission identified
- Consider admission CRE surveillance cultures (i.e., active surveillance) of high-risk patients particularly in higher prevalence areas
- Consider cohorting patients and staff

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- Ensure if patient transferred within the facility that precautions are continued. Ensure, if discharged and readmitted, there is a mechanism to identify patient at readmission
- Ensure if patient transferred to another facility, CRE status is communicated to accepting facility

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