Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE)

2013 Oregon Toolkit

Oregon Health Authority

CENTER FOR PUBLIC HEALTH PRACTICE
Acute and Communicable Disease Prevention Program

Phone: 971-673-1111
Fax: 971-673-1100
www.healthoregon.org/acd

Outline

Overview: Oregon CRE Toolkit 4

Oregon Health Authority CRE Definition 5

Recommendations for CRE Infection Prevention and Control in Acute and Long-Term Acute Care Hospital Settings 9

Recommendations for CRE Infection Prevention and Control in Long-Term Care Facilities 14

Recommendations for CRE Infection Prevention and Control in Ambulatory Care Settings 19

Recommendations for Microbiology Laboratories 21

References 24

Appendices 25

a. CRE Interfacility Transfer Form 27

b. CDC Laboratory Screening Culture Protocol 28

c. Surveillance Swab Protocol 34

d. CRE Assessment Tiers 36

e. CRE Response Diagram for Infection Control 38

f. CRE Response Diagram for Laboratories 39

g. CDC Environmental Cleaning Monitoring Tool 40

h. Screening Culture Sample Letter for Staff 41

i. Screening Culture Sample Letter and Consent for Patients 42

j. Educational Materials: CDC CRE Vital Signs 43

k. Educational Materials: Basic CRE FAQ 47

l. Educational Materials: Advanced CRE FAQ 48

m. Educational Materials: Patient Safety Tips 51

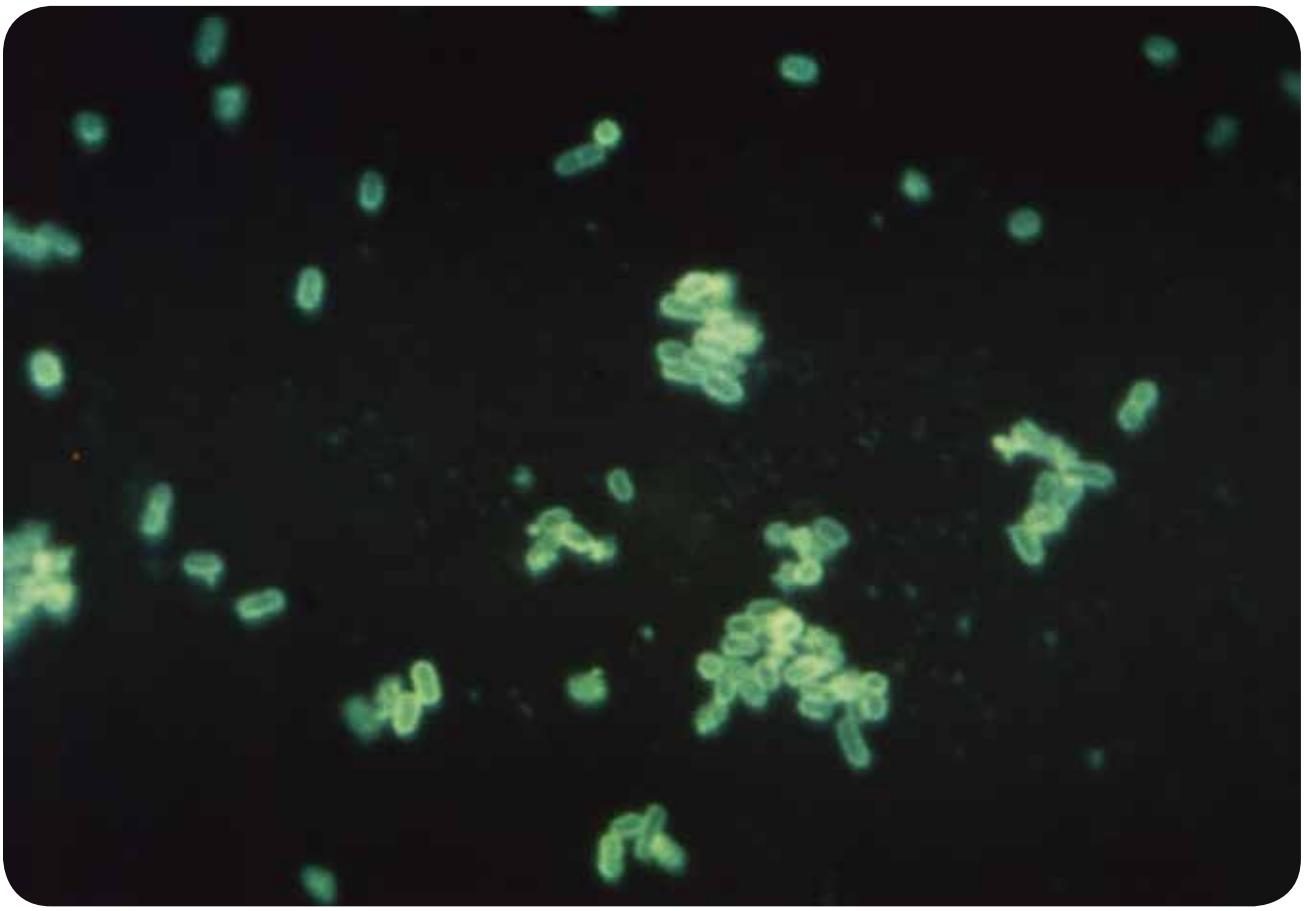
n. Oregon Public Health Practice Stories from the Field 52

o. Educational Materials: CRE Education for Staff 54

Overview: Oregon CRE Toolkit

The Oregon CRE Toolkit is designed as a practical working document to aid the health care workforce groups most predictably involved in the detection, treatment, and prevention of CRE in Oregon, namely infectious diseases physicians, health care epidemiologists, infection preventionists, nurses, and microbiologists. The Oregon CRE Toolkit is modeled after the 2012 CDC CRE Toolkit (http://www.cdc.gov/hai/organisms/cre/cre-toolkit/) but includes Oregon-specific definitions, recommendations and protocols.

This Toolkit was created with CDC funding.



Fluorescent antibody stained photomicrograph of *Escherichia coli*

Oregon Health Authority CRE Definition

Enterobacteriaceae that…

a. Are non-susceptible (i.e., intermediate or resistant) to ANY carbapenem (e.g., doripenem, ertapenem, imipenem, meropenem) AND resistant to ANY of the following 3rd generation cephalosporins tested: cefotaxime, ceftriaxone, or ceftazidime; OR

b. Possess/contain a gene sequence specific for carbapenemase (PCR); OR

c. Are positive for carbapenemase production by a phenotypic test (e.g., Modified Hodge Test).

Note, the Oregon CRE definition differs from CDC 2012 CRE Toolkit interim surveillance definition. The Oregon definition is slightly broader; the goal is to detect all cases of carbapenemase-producing CRE (CP-CRE) by the surveillance system.

Given the heterogeneity of CRE, when assessing the relative importance of a particular organism, refer to the following "CRE Tiers":

Tier 1:
Carbapenemase-Producing CRE (CP-CRE)

CP-CRE are very rare in Oregon[1], critically important for public health, and require the most aggressive infection control measures.

Tier 1 organisms are defined as Enterobacteriaceae (all spp.) that are either PCR positive for carbapenemase production (KPC, NDM, VIM, IMP, or OXA-48) or Enterobacteriaceae (other than *Enterobacter* spp.) that are Modified Hodge Test positive for carbapenemase production.

Upon transfer to another facility, the transferring facility must: (1) complete an Interfacility Transfer Form documenting the presence or history of the patient's CP-CRE; and (2) notify the local health department (e.g., fax Interfacility Transfer Form).

Tier 2:
CRE with acquired resistance NOT due to carbapenemase production

These organisms are uncommon in Oregon, are important to control at the facility level, and require intensified infection control measures, including contact precautions.

[1] Note that all statements are meant to be accurate as of April, 2013, when this toolkit was published. Frequency of organisms for this and subsequent statements may change post publication.

Most CRE reported in Oregon qualify as Tier 2 organisms. These include *Enterobacter* spp. that may be Modified Hodge Test positive while PCR-negative for carbapenemase. See exceptions above for CP-CRE (Tier 1) and below for intrinsically resistant CRE (Tier 3).

Tier 3:
CRE due to intrinsic (natural) resistance

These CRE are neither public health nor facility-wide infection control threats and do not require specific implementation of special infection control measures.

CRE in this category are *Proteus* spp., *Providencia* spp., and *Morganella* spp. which demonstrate ONLY imipenem non-susceptibility (and test doripenem, ertapenem, or meropenem susceptible). For example, a *Morganella morganii* isolate that tests imipenem-resistant AND ertapenem-susceptible is included in Tier 3. *Many of these organisms are excluded from the Oregon CRE definition because they do not meet the requirement for 3rd generation cephalosporin resistance.*

Challenges with Defining CRE

Though Oregon has created a specific definition for CRE that we hope is clear and easy to follow, several issues can cause confusion:

a. Lack of awareness about which bacteria are considered to be Enterobacteriaceae;

b. Lack of adoption of recent 2010 and 2012 updates to the interpretive criteria for carbapenem susceptibility among Enterobacteriaceae, as determined by the Clinical and Laboratories Standards Institute (CLSI);

c. Ambiguity about whether carbapenem non-susceptible (i.e., intermediate or resistant) organisms or strictly carbapenem resistant organisms should be classified as "CRE";

d. Inability to rapidly identify the resistance mechanism (carbapenemase vs. other); and

e. Uncertainty if knowledge of the resistance mechanism should impact the infection control response.

In an attempt to clarify these issues, a reference guide of relevant terminology is included below.

Reference Guide to CRE

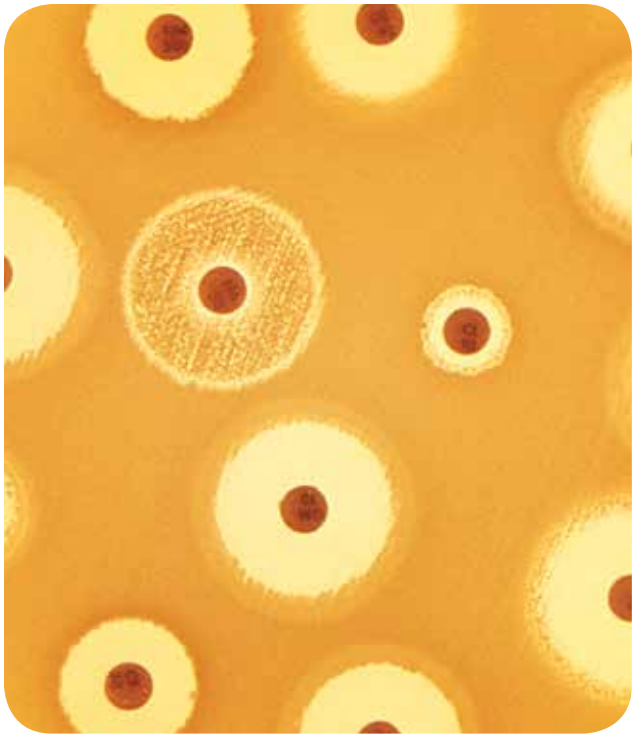
Enterobacteriaceae are a large family of gram negative bacilli (i.e., gram negative rods) mostly found in the gastrointestinal tract.

- Commonly encountered Enterobacteriaceae are *E. coli, Klebsiella* spp., *Enterobacter* spp., *Proteus* spp., *Providencia* spp., *Morganella* spp., *Citrobacter* spp., *Serratia* spp., and *Salmonella* spp. A complete list is available at http://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/CRE/Documents/genera_list.pdf.

- ***Pseudomonas* spp. and *Acinetobacter* spp. are NOT Enterobacteriaceae.** Carbapenem resistance in these species is also clinically important but beyond the scope of this document.

Carbapenems are an antibiotic class that includes doripenem, ertapenem, imipenem, and meropenem.

- **Ertapenem** is the most sensitive but least specific carbapenem used to screen for CRE. For laboratories using the Clinical and Laboratories Standards Institute (CLSI) breakpoints pre-dating the 2010 update, ertapenem non-susceptibility may be the only indicator of CRE whose carbapenem resistance is due to the production of a carbapenemase enzyme.
- ***Proteus* spp., *Providencia* spp., and *Morganella* spp.** are intrinsically (i.e., "naturally") non-susceptible to imipenem. For laboratories using the revised 2012 CLSI breakpoints, it is common to encounter imipenem non-susceptible organisms (MICs 2–4 µg/mL). This is to be expected and generally of no concern. Therefore, *Proteus* spp., *Providencia* spp., and *Morganella* spp. which demonstrate ONLY imipenem non-susceptibility (and test doripenem, ertapenem, or meropenem susceptible) are often excluded from CRE case definitions. However, non-susceptibility to the other carbapenems indicates acquired resistance, is unusual, and concerning.



Kirby-Bauer antibiotic susceptibility test

CRE resistance mechanisms are divided into 2 major categories: carbapenemase or other (non-carbapenemase). Ideally, knowledge of the mechanism of resistance impacts infection prevention and control response. Unfortunately, routine susceptibility testing in the microbiology laboratory does not reliably differentiate the resistance mechanism.

- **Carbapenemases** are enzymes the bacteria produce that inactivate carbapenems directly. CP-CRE are primarily responsible for the ***worldwide*** spread of CRE. One reason for this rapid dissemination is that carbapenemase enzymes are typically located on plasmids that facilitate transmission within and between bacterial species. Carbapenemases of global

importance include *Klebsiella pneumoniae* carbapenemase (KPC), New Delhi metallo-β-lactamase (NDM), Verona integron encoded metallo-β-lactamase (VIM), imipenemase metallo-β-lactamase (IMP), and oxacillinase-48 (OXA-48). In 2013, KPC is the most widespread carbapenemase in the USA and, to date, is the only carbapenemase that has been reported in Oregon.

- **Non-carbapenemase** resistance is mediated by a combination of mechanisms, typically via production of an extended spectrum β-lactamase or extended spectrum cephalosporinase *plus* decreased permeability of the bacterial cell wall (e.g., porin mutations). Although also highly multi-drug resistant, these organisms are currently thought to have ***local*** (i.e., unit- or facility-wide) rather than global impact; unlike the CP-CRE, the number of non-carbapenemase producing CRE has remained relatively stable over time.

Detection methods for Carbapenemase-Producing CRE (CP-CRE)

- **Gene sequence specific for carbapenemase (PCR):** direct testing for the carbapenemase genes (KPC, NDM, VIM, IMP, OXA-48) is the most accurate way to detect CP-CRE. Carbapenemase PCR testing is not widely available. The Oregon State Public Health Laboratory is establishing capacity to perform rapid PCR testing for KPC and NDM, which should be completed by time of publication.
- **Modified Hodge Test (MHT):** a laboratory test that relies on specific growth characteristics of the organism to indirectly assess carbapenemase production. While MHT is accurate for detection of KPC-production in *E. coli* and *Klebsiella* spp., MHT is not accurate for detection of KPC-production in Enterobacter spp. Also, MHT performance appears to be variable for other types of CP-CRE (i.e., NDM, VIM, IMP, OXA-48). MHT is performed at the Oregon State Public Health Laboratory and several other microbiology laboratories throughout Oregon.

Why 3rd generation cephalosporins are relevant to CRE

- **Almost all CP-CRE** are also resistant to 3rd generation cephalosporins. This additional requirement to the CRE case definition increases the specificity for the detection of CP-CRE.
    - OXA-48 carbapenemases, currently extremely rare in North America, are an exception: they are typically carbapenem resistant but 3rd generation cephalosporin susceptible.
- **Ceftriaxone, cefotaxime, and ceftazidime** are the 3rd generation cephalosporins specifically included in the case definition because these three agents are recommended as part of the primary or secondary susceptibility panels for Enterobacteriaceae.
- Note: cefepime is a 4th generation cephalosporin and thus excluded from the case definition.

Recommendations for CRE Infection Prevention and Control in Acute and Long-Term Acute Care Hospital Settings[2]

Think "NICE" when CRE are encountered:

N **otify** the county health department, pertinent clinician groups, and the antibiotic stewardship program to presence of CRE in the facility. Additionally, for carbapenemase-producing (CP-CRE), notify hospital administration.

I **ntervene** on all cases with core infection prevention and control strategies: hand hygiene, contact precautions, private rooms, and optimized environmental cleaning. Reduce unnecessary antibiotics and use of invasive devices. Additionally, for CP-CRE, screen patient contacts and cohort staff and patients.

C **ommunicate** CRE infection or colonization status to the receiving facility upon patient transfer.

E **ducate** patients, staff, and visitors about CRE.

Part 1:
General Measures for CRE prevention

1. **Educate the clinical staff about CRE.** Consider giving an in-service to staff about CRE and other multi-drug resistant gram-negative rods. Sample CRE educational materials are attached; additional materials are available at https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/Pages/disease.aspx?did=108.
2. **Review your facility's CRE definition to determine any differences with the above OHA definition.** Also, refer to the detailed description in the microbiology laboratory section. Become familiar with which CLSI criteria your microbiology laboratory uses to detect and report CRE, and verify with the laboratory that this method is adequate.
3. **Ensure adequate processes are in place to facilitate rapid notification of clinical and IPC staff when CRE are identified in the microbiology laboratory.**

[2] For the purpose of this document, we define acute care and long-term acute care hospitals (LTACH) as health care settings that manage complex medical care and rehabilitation of patients with multiple acute health care needs (e.g., respiratory ventilators, indwelling devices, intravenous injections, and complex wound care).

4. **Review microbiology laboratory records for the past 12 months** (or since the latest review) to identify any previously unrecognized cases of CRE. Consult your laboratory personnel if assistance is needed in conducting this review.

    - If previously unrecognized cases are found, conduct a point prevalence survey in consultation with OHA. Surveys should concentrate on areas of the facility at highest risk for transmission, and include units where patients with unrecognized CRE were housed. Refer to the microbiology laboratory guidelines for how to collect and process specimens.

5. **If possible, perform active surveillance cultures for patients who are at high-risk for CRE colonization upon hospital admission.** For example, one suggested strategy is to screen newly admitted patients who have been hospitalized overnight outside of Washington and Oregon within the past 6 months.

PPE

Part 2:
Specific Recommendations for the Infection Prevention and Control Program when CRE is identified at your facility

1. **Notify the county health department** of the county of residence within 1 business day of identification of CRE-infected or CRE-colonized patient (e.g., a new CRE case or known CRE case accepted in transfer from out-of-state to the facility). Both laboratories and clinicians are required to report cases.

2. **Assess the relative importance (or "tier") of CRE.**

    - Pending results of carbapenemase confirmation, initially manage all CRE with acquired resistance (Tiers 1 and 2) similarly as outlined in this section.

    - Carbapenemase-Producing CRE (CP-CRE; Tier 1) have specific additional recommendations outlined at the end of this section.

    - For CRE with natural resistance to carbapenems (Tier 3), stop here! Tier 3 CRE do not require specific infection prevention and control interventions.

    - Remember, *Pseudomonas* spp. and *Acinetobacter* spp. are not Enterobacteriaceae; you do not have to report to public health.

3. **Review microbiology** records to identify any other CRE cases at the facility within the past 12 months (or since the latest review).

4. **Promote Hand Hygiene (HH) and monitor HH adherence.** If feasible in your setting, specifically monitor the rooms occupied by CRE-infected or colonized patients to ensure adherence to proper hand hygiene and contact precautions.

5. **Place CRE-infected and CRE-colonized patients in Contact Precautions.** Empower the nursing (and other) staff to monitor and enforce contact precautions.

    - Continue contact precautions for the duration of hospitalization.
    - "Flag" the charts of CRE-positive patients so that they can be identified and placed in contact precautions immediately if re-admitted.

6. **Place CRE-infected and CRE-colonized patients in private rooms.** If the number of single patient rooms is limited, reserve these rooms for patients with highest risk for transmission (e.g., incontinence). Cohort CRE-positive patients in the event that private rooms are unavailable.

7. **Optimize environmental cleaning.** Alert Facilities Management Services (or housekeeping equivalent) to the room number of any CRE-infected or CRE-colonized patient. Encourage thorough cleaning of high-touch surfaces in the room, particularly near the patient (e.g., bed, bed rails, table), and outside the room in common areas. Ensure daily and terminal room cleaning is performed using an EPA-approved disinfectant. When resources are available, monitor the thoroughness of the terminal clean (e.g., UV fluorescence marker, ATP bioluminescence monitor, etc.; see Appendices for one suggested monitoring tool).

8. **Educate affected staff, patients, and visitors about CRE.** We recommend using the educational materials included in this Toolkit; though CRE are generally not a health risk to healthy people, staff and visitors can prevent spread within a facility.

9. **Notify pertinent clinician groups (Infectious Diseases, Critical Care, Pharmacy, etc.)** to presence of CRE in the facility as this may impact empiric antibiotic treatment.

10. **Notify antibiotic stewardship program** to presence of CRE in the facility with a goal to reduce overall facility antibiotic use. If your institution does not have a formal antibiotic stewardship program, consider using the CRE case(s) as one reason to initiate a program. Contact OHA for information on antimicrobial stewardship.

11. **Directly interface with clinicians caring for the CRE infected or colonized patient.** Encourage the treating clinicians to limit antibiotic exposure and the use of invasive devices to the greatest extent possible.

12. **Consider chlorhexidine bathing** for high-risk patients (e.g., all patients located in the same unit), particularly if >1 CRE infection or colonization is identified. See CDC Toolkit and contact the pharmacy for dosing recommendations. Chlorhexidine bathing was reported as part of a successful CRE-eradication strategy during CRE outbreaks in both acute care and long- term acute care facilities in Florida.

13. **If a CRE-infected or CRE-colonized patient transfers to another facility, use the Interfacility Transfer Form provided in this Toolkit.** Use this in addition to your usual means of communication with receiving facilities re: other MDROs. Make sure that the appropriate individuals at the receiving facility are aware of the patient's CRE status.

Additional measures for carbapenemase-producing CRE (CP-CRE):

14. **For CP-CRE, notify hospital administration.** CRE prevention and control should be an institutional priority and will require executive leadership and monetary support.

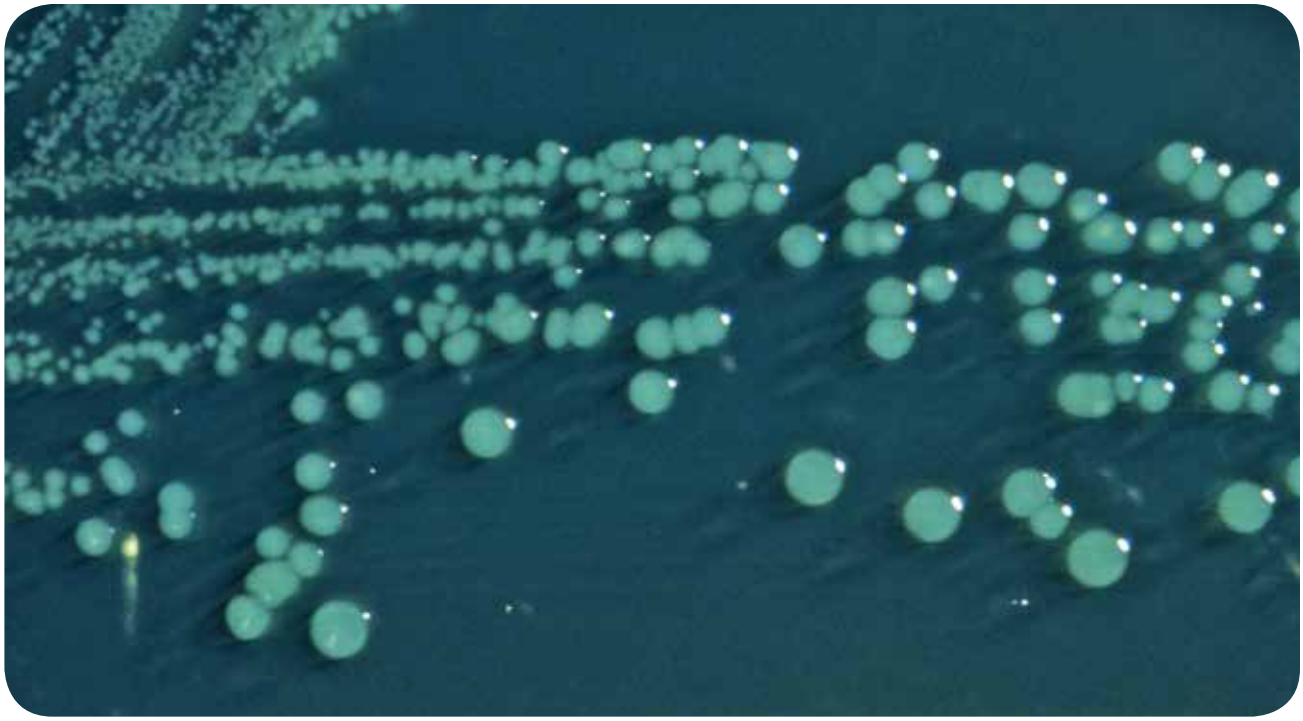
15. **For CP-CRE, cohort nursing staff that care for CRE-positive patients as resources allow.** This is most important and feasible for multiple patients with CP-CRE hospitalized at the same time. However, cohorted nursing, even down to 1:1, has been successfully employed as part of a comprehensive CRE control strategy in several reports.

16. **For CP-CRE, notify local health department in addition to receiving facility upon patient transfer (e.g., fax Interfacility Transfer Form).**

17. **For CP-CRE, obtain CRE screening cultures for high-risk contacts to the case patient *in consultation with OHA.*** Screen starting with the highest risk contacts based on the following factors: a) proximity to case patient; b) shared health care providers (nurses, physicians, and staff); c) the intensity of nursing required; d) stool and urine incontinence; e) and length of stay. Other local factors should be considered. Expand the screening pool if initial testing reveals additional CRE-colonized patients.

    Pertinent details include:

    - The microbiology laboratory section of this Toolkit contains the recommended screening protocol.
    - Use a similar consent policy, if necessary, as would be used for other multidrug-resistant organism screening (i.e., MRSA, VRE) in your facility (see Appendix for sample consent form).
    - Specimens for screening cultures may be obtained by anyone who is qualified to collect specimens for culture (see Appendix).



Shigella boydii

- Recommended screening sites are stool, rectal or peri-rectal swabs in all patients. Enhanced sensitivity may be achieved by screening additional sites, including groin, urine (if catheter present), or wound (if present). The cost-benefit ratio of screening additional sites is uncertain and therefore not routinely recommened.
- Screening cultures should NOT be billed to the patient; funds for surveillance cultures should derive per usual practice from the affected health care facility (e.g., quality and performance, infection control, or microbiology laboratory budget).
- Keep a record of screening culture results and "flag" any CRE-colonized patient for epidemiologic purposes (e.g., contact precautions, etc.). The decision of whether to enter or withhold results of screening tests as microbiology laboratory reports in the clinical chart should be made at the facility level.

Recommendations for CRE Infection Prevention and Control in Long-Term Care Facilities[3]

Think "NICE" when CRE are encountered:

N **otify** the county health department and pertinent clinician groups to presence of CRE in the facility. Additionally, for carbapenemase-producing CRE (CP-CRE), notify facility administration.

I **ntervene** on all cases with core infection prevention and control strategies: hand hygiene, standard or contact precautions (when indicated), private rooms (if feasible), and optimized environmental cleaning. Reduce unnecessary antibiotics and use of invasive devices.

C **ommunicate** CRE infection or colonization status to the receiving facility upon patient transfer.

E **ducate** patients, staff, and visitors about CRE

Part 1:
General Measures for CRE prevention

1. **Educate the clinical staff about CRE.** Consider giving an in-service to staff about CRE and other multi-drug resistant gram negative rods. Sample CRE educational materials are attached; materials are available at https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/Pages/disease.aspx?did=108.
2. **Ensure adequate processes are in place to facilitate rapid notification of clinical and IPC staff** when multi-drug resistant organisms (MDROs), such as CRE, are identified in the microbiology laboratory.
3. **Review microbiology laboratory records for the past 12 months to identify any previously unrecognized cases of CRE.** Consult your laboratory personnel if assistance is needed in conducting this review.

[3] For the purposes of this document, long- term care facilities (LTCF) are health care settings that provide rehabilitative, restorative and/or ongoing skilled nursing care to patients or residents in need of assistance with activities of daily living. Long- term care facilities include skilled nursing homes, rehabilitation facilities, inpatient behavioral health facilities, and long- term chronic care hospitals.

- If previously unrecognized cases are found, conduct a point prevalence survey *in consultation with OHA.* Surveys should concentrate on areas of the facility at highest risk for transmission, and include units where residents with unrecognized CRE were housed. Refer to the microbiology laboratory guidelines for how to collect and process specimens.

Part 2:
Specific Infection Control Recommendations when CRE-infection or CRE-colonization is identified at your facility

1. **Notify the local county health department** within 1 business day of identification of CRE-infected or CRE-colonized resident (e.g., a new CRE case or known CRE case accepted in transfer from out-of-state to the facility).
2. **Review your facility's microbiology records** to identify any other CRE cases at the facility within the past 12 months (or since the latest review).
3. **Promote Hand Hygiene (HH) and, if feasible, monitor HH adherence. This is the most important aspect of preventing CRE transmission!**
4. **Place residents who are at higher risk for CRE-transmission in contact precautions.** Contact precautions are recommended for higher risk residents when they are in their room receiving care (and not when residents leave their room for group activity). Residents with CRE should not be discouraged from participating in daily community meals and activities.

Examples of higher risk residents for whom contact precautions are strongly recommended:

- Post-acute care residents still debilitated by recent hospitalization;
- Totally dependent on assistance for activities of daily living (ADLs);
- Ventilator-dependent;
- Uncontained incontinence of stool;
- Uncontained incontinence of urine (if site of CRE is urinary);
- Wounds with difficult to control drainage.

Examples of lower risk residents for whom contact precautions are not specifically recommended:

- Residents who are able to perform hand hygiene, continent of stool, less dependent on staff for their activities of daily living, and without draining wounds.
- Residents whose incontinence or draining wounds can be contained.

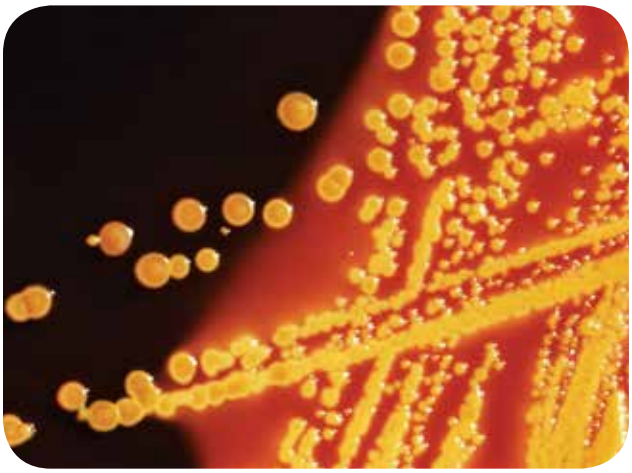
However, in these situations standard precautions should still be observed, including the use of gloves and/or gowns when contact with colonized/infected sites

or body fluids is possible. Consult public health for individualized case recommendations when the need for contact precautions is uncertain.

Discontinue contact precautions when either of the subsequent criteria is met:

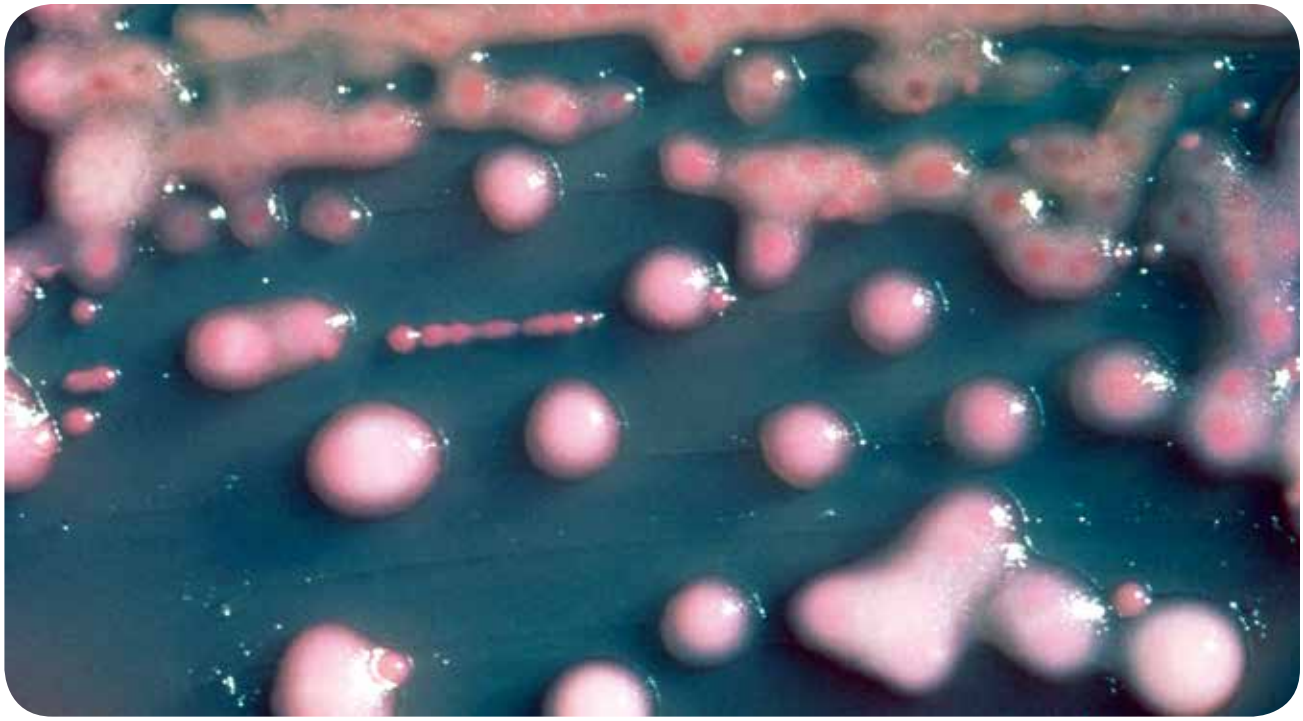
- Resident has negative surveillance cultures per the following algorithm, provided surveillance cultures can be performed:
    - Three screening cultures (stool, rectal, or peri-rectal) are negative, each culture obtained at least one week apart, and all three obtained ≥3 months after the most recently documented positive CRE culture (infection and/or colonization).
- Resident becomes lower-risk for CRE transmission (see examples of risk above).

5. **If >1 CRE case is identified at the facility, attempt to house them in same room or wing (i.e., cohort the residents).** If feasible, use single bed rooms for CRE-infected or CRE-colonized residents. Typically, the use of single resident rooms with "isolation" is reserved only for residents treated for active CRE infection with high risk of CRE transmission. "Isolation" is considered a higher level of restriction than the contact precautions discussed above.



Escherichia coli grown on Hektoen Enteric agar

6. **Optimize environmental cleaning.** Alert facilities management services (or housekeeping equivalent) to the room number of any CRE-infected or CRE-colonized resident. Encourage thorough cleaning of high-touch surfaces in the room, particularly near the resident (e.g., bed, bed rails, table), and outside the room in common areas. Ensure room cleaning is performed using an EPA-approved disinfectant. If feasible, monitor the thoroughness of the terminal clean (e.g., UV fluorescence marker, ATP bioluminescence monitor, etc.; see Appendix for one suggested monitoring tool).
7. **Educate affected staff, residents, and visitors about CRE.** We recommend using the educational materials included in this Toolkit. CRE are generally not a health risk to well persons; however, staff and visitors can prevent spread within a facility.
8. **Notify appropriate clinicians (Medical Director, Pharmacy, etc.)** to presence of CRE in the facility. Important considerations are:



Klebsiella pneumoniae grown on MacConkey agar

- Limit use of invasive devices (i.e., catheters, tubes) in all residents.
- Stop unnecessary antibiotic use. Encourage attempts to document infection prior to antibiotic administration. If possible (and not already routinely performed), review antibiotics prescriptions to determine appropriateness.

9. **If a CRE-infected or colonized resident transfers to another facility, use the Interfacility Transfer Form provided in this Toolkit.** Use this in addition to your usual means of communication with receiving facilities re: other MDROs. Be confident that the appropriate individuals at the receiving facility are aware of the resident's CRE status.
10. **If a CRE-infected or colonized resident is discharged home, re-educate the resident about CRE colonization (for future health care encounters) and notify the resident's primary care provider of the diagnosis.** This will potentially help the individual during future medical treatment and assist public health in tracking CRE.

Additional Measures for Carbapenemase-producing CRE (CP-CRE):

11. **For CP-CRE, notify facility administration.** CRE control should be an institutional priority and will require executive leadership and monetary support.

12. **For CP-CRE, notify local health department in addition to receiving facility upon resident transfer to another health care facility (e.g., fax the Interfacility Transfer Form).**

13. **For CP-CRE, obtain CRE screening cultures for high-risk resident contacts *in consultation with OHA.*** Screen starting with the highest risk contacts based on the following factors: a) proximity to CRE-positive resident, b) shared health care providers, c) the intensity of nursing required, d) stool or urine incontinence, e) and length of stay. Other local factors should be considered. Expand the screening pool if initial testing reveals additional CRE-colonized patients.

    Pertinent details include:

    - The microbiology laboratory section of this Toolkit contains the recommended screening protocol.
    - Use a similar consent policy, if necessary, as would be used for other multidrug-resistant organism screening (i.e., MRSA, VRE) in your facility (see appendix for sample consent form).
    - Specimens for screening cultures may be obtained by anyone who is qualified to collect specimens for culture.
    - Recommended screening sites are stool, rectal or peri-rectal swabs in all residents. Enhanced sensitivity may be achieved by screening additional sites, including groin, urine (if catheter present), and/or wound (if present). The cost-benefit ratio of screening additional sites is uncertain and therefore not routinely recommened.
    - Screening cultures should NOT be billed to the resident; funds for surveillance cultures should derive as per usual practice from the affected health care facility (e.g., quality and performance, infection control and/or microbiology laboratory budget).
    - Keep a record of screening culture results and “flag” any CRE-colonized resident for epidemiologic purposes (e.g., contact precautions, etc.). The decision of how to additionally place (or withhold) results of screening test in the clinical chart as a microbiology laboratory result should be made at the facility level.

Recommendations for CRE Infection Prevention and Control in Ambulatory Care Settings

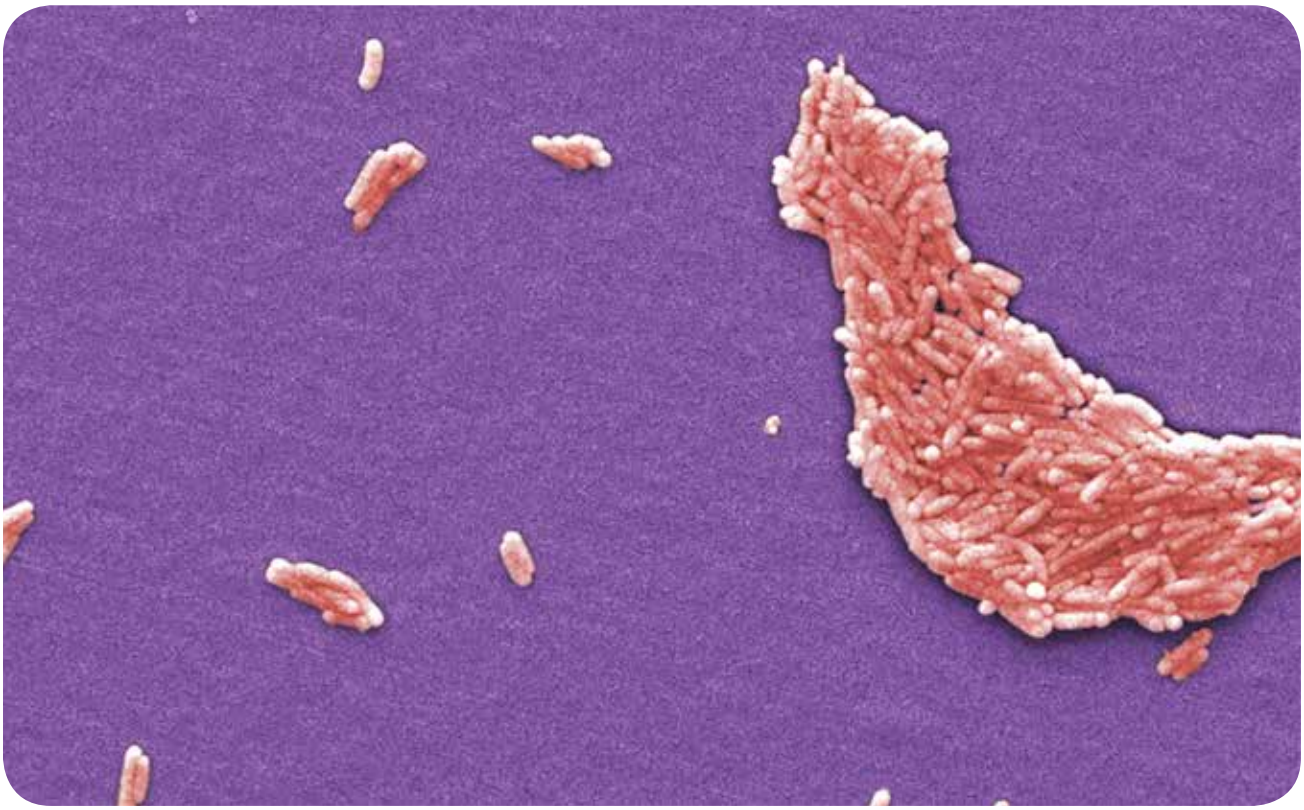
Standard Precautions are recommended. In May, 2011, CDC published a summary of ambulatory care infection prevention and control recommendations entitled the "GUIDE TO INFECTION PREVENTION FOR OUTPATIENT SETTINGS: Minimum Expectations for Safe Care." The most pertinent infection prevention and control measures for CRE (and other MDROs) in the ambulatory setting are (a) adherence to hand hygiene (HH) and (b) proper use of personal protective equipment (PPE). Key recommendations for each item in the document are copied below.

Key recommendations for hand hygiene in ambulatory care settings:

1. **Key situations where hand hygiene should be performed include:**
    - Before touching a patient, even if gloves will be worn
    - Before exiting the patient's care area after touching the patient or the patient's immediate environment
    - After contact with blood, body fluids or excretions, or wound dressings
    - Prior to performing an aseptic task (e.g., placing an IV, preparing an injection)
    - If hands will be moving from a contaminated-body site to a clean-body site during patient care
    - After glove removal
2. **Use soap and water when hands are visibly soiled** (e.g., blood, body fluids), or after caring for patients with known or suspected infectious diarrhea (e.g., *Clostridium difficile,* norovirus). Otherwise, the preferred method of hand decontamination is with an alcohol-based hand rub.

Key recommendations for use of PPE in ambulatory care settings:

1. **Facilities should assure that sufficient and appropriate PPE is available and readily accessible to HCP.**
2. **Educate all HCP on proper selection and use of PPE.**
3. **Remove and discard PPE before leaving the patient's room or area.**
4. **Wear gloves for potential contact with blood, body fluids, mucous membranes, non-intact skin or contaminated equipment.**
   - Do not wear the same pair of gloves for the care of more than one patient.
   - Do not wash gloves for the purpose of reuse.
   - Perform hand hygiene immediately after removing gloves.
5. **Wear a gown to protect skin and clothing during procedures or activities where contact with blood or body fluids is anticipated.**
   - Do not wear the same gown for the care of more than one patient.
6. **Wear mouth, nose and eye protection during procedures that are likely to generate splashes or sprays of blood or other body fluids.**
7. **Wear a surgical mask when placing a catheter into the spinal canal or subdural space or injecting material into these spaces.**



Scanning electron micrograph (SEM) of *Salmonella typhimurium*

Recommendations for Microbiology Laboratories

1. **Determine carbapenem susceptibility following the CLSI-recommended procedures and interpretive criteria.** In 2010, CLSI lowered susceptibility breakpoints for testing Enterobacteriaceae to carbapenems. In 2012, ertapenem was adjusted again (increased slightly). The 2012 breakpoints increased the sensitivity for carbapenemase detection; laboratories using the 2012 breakpoints do not need to perform a "confirmatory" Modified Hodge Test (MHT) for patient management.

OHA administered a statewide survey in December 2012 and found that most Oregon microbiology laboratories used CLSI breakpoints predating the 2010 update and did not perform MHT for confirmatory carbapenemase testing. This is a potential gap in our ability to detect and report carbapenemase-producing CRE (CP-CRE). **We recommend that laboratories using pre-2010 breakpoints perform carbapenemase screening and confirmation via MHT.**

The breakpoint changes are summarized in the following table:

	Breakpoints Predating 2010 Update (µg/ml)[1] (through Jan. 2010; M100-S19)			2012 Breakpoints (µg/ml) (revised Jun. 2010 and Jan. 2012[2]; M100-S22)		
	Susceptible	Intermediate	Resistant	Susceptible	Intermediate	Resistant
Doripenem	n/a	n/a	n/a	≤1	2	≥4
Ertapenem	≤2	4	≥8	≤0.5	1	≥2
Imipenem[3]	≤4	8	≥16	≤1	2	≥4
Meropenem	≤4	8	≥16	≤1	2	≥4

[1] For laboratories using the CLSI breakpoints predating the 2010 update, Enterobacteriaceae demonstrating ANY carbapenem MIC ≥2 (i.e., "positive carbapenemase screen") AND *ANY* 3rd generation cephalosporin resistance should undergo confirmatory testing via Modified Hodge Test (MHT). **If your laboratory does not perform MHT, send all isolates meeting the above screening criteria to OSHPL for confirmatory MHT testing.**

[2] Ertapenem MIC breakpoints changed twice; 1st lowered in June 2010 with the other carbapenems, then increased back up (slightly) in January 2012.

[3] MICs of *Proteus* spp., *Providencia* spp., and *Morganella* spp. to imipenem are intrinsically higher due to mechanisms typically unrelated to carbapenemases. Laboratories testing these organisms to imipenem can expect to commonly encounter imipenem non-susceptible isolates using revised (M100-S22) breakpoints.

2. **Report CRE to your county health department within 1 business day.** Use the OHA case definition as follows:

   Enterobacteriaceae that…

   a. **Are non-susceptible (i.e., intermediate or resistant) to ANY carbapenem (e.g., doripenem, ertapenem, imipenem, meropenem) AND resistant to ANY of the following 3rd generation cephalosporins tested: cefotaxime, ceftriaxone, or ceftazidime; OR**

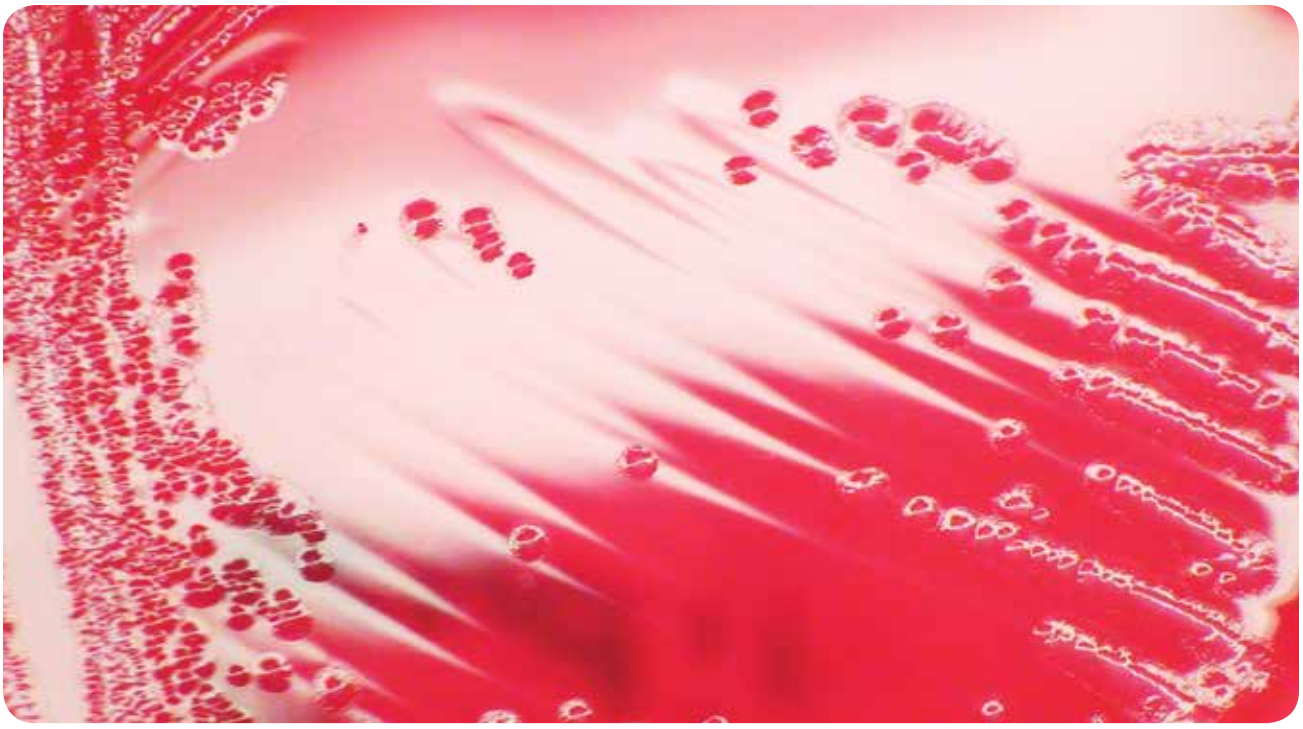
   b. **Possess/contain a gene sequence specific for carbapenemase (PCR); OR**

   c. **Are positive for carbapenemase production by a phenotypic test (e.g., Modified Hodge Test).**

   NOTE: For laboratories in the Tri-County Portland Metro area, the OHA CRE definition is slightly more sensitive than that of EIP MuGSI program surveillance; all laboratories should use the Oregon CRE definition for CRE reporting.

3. **Send *E. coli, Klebsiella* spp., and *Enterobacter* spp. isolates that meet the OHA CRE case definition to the Oregon State Public Health Laboratory (OSPHL) for further testing.** Isolates other than *E. coli, Klebsiella* spp., and *Enterobacter* spp. that that meet the OHA CRE case definition may be requested by the state on a case-by-case basis.

   OSPHL will perform the Modified Hodge Test and, beginning summer 2013, PCR for common carbapenemases in real-time. OSPHL will forward



Shigella boydii grown on sheep's blood agar

a subset of the isolates to Centers for Disease Control and Prevention for further analysis (not real-time). OSPHL will fax results to your laboratory within 3 business days.

How to send isolates:

Use the red General Microbiology Request Form (form 60). Each form has a unique barcode for tracking purposes; therefore forms are not available on-line. If labs need more forms, order them directly from OSPHL.

- In "tests requested", check "other" under isolate identification and write "CRE".
- In "comments", please indicate genus and species.
- Send the susceptibilities along with the isolate.
- Send isolate preferably on a slant; a plate is also acceptable.
- All request forms and specimens must have at least two patient identifiers (e.g., name, date of birth, requisition bar code). Also include collection date, source of specimen, and patient medical record number.

Send to:
OSPHL
3150 NW 229th Ave, Suite 100
Hillsboro, OR 97124-6536
Phone: 503-693-4100
Fax: 503-693-5604

4. **CRE screening cultures for case contacts should be performed as recommended by local facility's Infection Prevention and Control staff *in consultation with OHA.*** The number of surveillance cultures requested will be based on pertinent epidemiology.
    - The recommended protocol for screening cultures is included in the appendices. If your laboratory does not have ertapenem (preferred) or meropenem (alternative) disks, contact OSPHL. Confirm candidate CRE organisms via routine identification and susceptibility; send all confirmed CRE isolates to OSPHL.
    - Screening cultures should NOT be billed to the patient; discuss billing with Infection Prevention and Control.
    - Discuss how results of screening cultures will be reported with Infection Prevention and Control.

References

1. APIC, 2010. Guide to Elimination of Multidrug-resistant *Acinetobacter baumannii* Transmission in Healthcare Settings.
2. CDC 2012 CRE Toolkit: Guidance for Control of Carbapenem-resistant Enterobacteriaceae (CRE). Available at: http://www.cdc.gov/hai/organisms/cre/cre-toolkit/index.html; accessed 1/27/2013.
3. CDC Guide to Infection Prevention for Outpatient Settings: Minimum Expectations for Safe Care, May 2011. Available at: http://www.cdc.gov/HAI/settings/outpatient/outpatient-care-guidelines.html; accessed 3/26/2013.
4. CDC Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006. Available at: http://www.cdc.gov/hicpac/pdf/MDRO/MDROGuideline2006.pdf; accessed 1/27/2013.
5. CDC Health Advisory. New Carbapenem-Resistant Enterobacteriaceae Warrant Additional Action by Healthcare Providers. 2013; Feb 14. CDCHAN-00341-02-14-2013. http://emergency.cdc.gov/HAN/han00341.asp
6. Clinical and Laboratories Standards Institute. *M100-S22.* Wayne, PA. 2012.
7. Gopinath R et al. Infection prevention considerations related to New Delhi metallo-β-lactamase Enterobacteriaceae: A case report. Infect Control Hosp Epi 2013;34:99-100.
8. Gupta N et al. Carbapenem-resistant Enterobacteriaceae: epidemiology and prevention. Clin Infect Dis 2011;53:60-67.
9. Hardy E, et al. Carbapenem-resistant Enterobacteriaceae containing New Delhi metallo-beta-lactamase in two patients — Rhode Island, March 2012. MMWR 2012;61(24):446-448.
10. Schwaber M *et al.* Containment of a country-wide outbreak of carbapenem-resistant *Klebsiella pneumoniae* in Israeli hospitals via a nationally implemented intervention. Clin Infect Dis 2011;52:848-55.
11. Tzouvelekis L et al. Carbapenemases in *Klebsiella pneumoniae* and Other Enterobacteriaceae: an Evolving Crisis of Global Dimensions. Clin Micro Rev 2012;25(4):682-707.

Appendices

Multidrug-Resistant Organism: Interfacility Transfer Form

TRANSFERRING FACILITY: Please send this completed form with the EMS transporters
RECEIVING FACILITY: Please provide completed form to your facility's Infection Prevention & Control Program

- ➔ Use this form when transferring a hospitalized patient or long term care facility resident who is either *infected* or *colonized* with a multidrug-resistant organism (MDRO).

MDRO examples: methicillin-resistant *Staphylococcus aureus* **(MRSA)**, vancomycin-resistant Enterococci **(VRE)**, *Clostridium difficile* **(Cdiff),** carbapenem-resistant *Enterobacteriaceae* **(CRE),** and other multidrug-resistant gram negative rods **(MDR-GNR)**. CRE include E. *coli*, *Enterobacter spp*., and *Klebsiella spp*. organisms which are resistant to carbapenem antibiotics.

Patient/Resident name (Last, First, MI) _____

DOB_____/_____/_____

Transferring facility name:_____

City_____ State_____

Transferring facility contact: _____ Phone_____

Receiving facility name:_____

City_____ State_____

MDRO Information: ☐ MRSA ☐ VRE ☐ Cdiff ☐CRE ☐Other _____

If CRE or other, list the name: _____

Date of last documented positive culture: _____

The patient/resident has an *active* infection with the above organism: ☐Yes ☐No ☐Unk

The patient/resident is *colonized* with the above organism: ☐Yes ☐No ☐Unk

Location of infection (i.e., body site): _____

The patient/resident is currently on antibiotics: ☐Yes ☐No ☐Unk

The ptient/resident is currently on any precautions: ☐Yes ☐No ☐Unk

If yes, type of precaution: ☐Contact ☐Droplet ☐Isolation ☐Airborne ☐Other_____

ADDITIONAL COMMENTS:

Laboratory Protocol for Detection of Carbapenem-Resistant or Carbapenemase-Producing, *Klebsiella* spp. and *E. coli* from Rectal Swabs

Purpose

To identify patients colonized with carbapenem-resistant or carbapenamase-producing Enterobacteriaceae in the intestinal tract. Patients who grow these organisms should be placed on Contact Precautions (5) to prevent transmission of the resistant bacteria. The procedure described below is a modification of the procedure described by Landman et al. (4). See the procedural notes for steps in the procedure which can be modified.

Background

Carbapenem-resistant Enterobacteriaceae (CRE) are usually resistant to all β-lactam agents as well as most other classes of antimicrobial agents. The treatment options for patients infected with CRE are very limited. Healthcare-associated outbreaks of CRE have been reported. Patients colonized with CRE are thought to be a source of transmission in the healthcare setting (1). Identifying patients who are colonized with CRE and placing these patients in isolation precautions may be an important step in preventing transmission (6).

Carbapenem resistance in Enterobacteriaceae occurs when an isolate acquires a carbapenemase or when an isolate produces an extended-spectrum cephalosporinase, such as an AmpC-type β-lactamase, in combination with porin loss. In the United States, the most common mechanism of carbapenem resistance is the *Klebsiella pneumoniae* carbapenemase (KPC).

Detection of carbapenemase production is complicated because some carbapenemase-producing isolates demonstrate elevated but susceptible, carbapenem MICs. CLSI has published guidelines for detection of isolates producing carbapenemases (CLSI document M100) (2). For isolates that test susceptible to a carbapenem but demonstrate reduced susceptibility either by disk diffusion or MIC testing, performing a phenotypic test for carbapenemase activity, the Modified Hodge Test (MHT), is recommended.

Carbapenem resistance and carbapenemase-production in any species of Enterobacteriaceae is an infection control concern. However, the methodology described here focuses on the detection of carbapenem-resistant or carbapenemase-producing *Klebsiella spp* and *E. coli* as this facilitates performance of the test in the microbiology laboratory and, more importantly, because these organisms, especially *Klebsiella* spp. represent the vast majority of CRE encountered in the United States (3).

Reagents
5 ml Trypticase Soy Broth
10-µg carbapenem disks
MacConkey agar

Equipment
Vortex
35 ± ºC, ambient air

Supplies
100 µl calibrated pipettes
Forceps
Sterile loops

Specimen
Rectal swab or perianal swab specimen in suitable transport media

Special safety precautions
Biosaftey Level 2

Quality Control (QC)
The carbapenem disks that are used in this procedure should be quality control tested using disk diffusion methods and quality control strains as described in the CLSI guideline documents M2 and M100 (2,(2). For example, if the10-µg/mL meropenem disk is used in this procedure, test *E. coli* ATCC 25922 by the disk diffusion method using meropenem disks from the same lot. An acceptable control test will yield a zone size between 28-34 mm. Follow CLSI guidelines for frequency of disk QC testing and corrective action if results are out of range.

Procedure

Step 1 Day One	Aseptically, place one 10-µg ertapenem or meropenem disc in 5 ml trypticase soy broth (TSB) (see procedure note 1) Immediately inoculate the broth with the rectal culture swab Incubate overnight at 35 ± 2ºC, ambient air
Step 2 Day Two	Vortex and subculture 100 µl of the incubated broth culture onto a MacConkey agar plate (see procedure note 2) Streak for isolation Incubate overnight at 35 ± 2ºC, ambient air
Step3 Day Three	Examine the MacConkey agar for lactose-fermenting (pink-red) colonies. More than one colony morphology may represent different species of Enterobacteriaceae (see procedure note 3). It may be necessary to subculture representative colonies of each morphology type to a non-selective media for isolation and/or for susceptibility testing. Screen representative isolated colonies using a phenotypic test for carbapenemase production, such as the Modified Hodge Test (MHT) or test for carbapenem susceptibility using a standardized method and follow the CLSI guidelines for identification of carbapenemase-producing Enterobacteriaceae (see procedure note 4).
Step 4 Day Four	For CRE and/or MHT-positive isolates, perform species-level identification.

Interpretation/Results

Report all cultures that are positive for CRE or carbapenemase-producing Enterobacteriaceae to the appropriate infection control personnel. Contact Precautions should be implemented for all patients with positive cultures for CRE or carbapenemase-producing Enterobacteriaceae.

Quality assurance

The ability to recover CRE using this procedure could be assessed as follows: Inoculate 5mL of TSB containing the 10-ug carbapenem disk with a swab that was used to sample a known CRE-negative stool specimen. In addition, inoculate the TSB with 0.5 mL of a 1 x 10^5 CFU/mL suspension of a known carbapenemase-producing isolate (e.g., *K. pneumoniae* ATCC BAA-1705), (see procedural note 5 for suspension preparation) Proceed with Step 2 of the procedure. The carbapenemase-producing *K. pneumoniae* should be recovered on the MacConkey agar.

To test for specificity of the procedure, use a carbapenem susceptible *Klebsiella pneumoniae,* (e.g. ATCC 700603) and follow the same steps. The carbapenem susceptible *K. pneumoniae* isolate should not grow on the MacConkey agar.

Method limitations

1. Patients may be colonized with CRE or carbapenemase-producing Enterobacteriaceae at a concentration that is not detectable by this method. Studies described by Landman et al. and studies performed at the CDC suggest that the lower limit of detection is between ranges from 1 x 10^2 CFU/ mL to 1 x 10^6 CFU/ mL (4).

2. Non-fermenting gram-negative bacilli with intrinsic mechanisms of carbapenem-resistance, such as *Acinetobacter* spp. and *P. aeruginosa*, will be detected on the MacConkey agar. These isolates should be identified as non-lactose fermenters on the MacConkey agar and therefore would not be picked for characterization. If carbapenem-resistant non-fermenters are present at high concentration, they could overgrow CRE or carbapenemase-producing Enterobacteriaceae on the media and prevent detection of colonization.

3. Enterobacteriaceae can be resistant to carbapenems by mechanisms other than a carbapenemase, the most common of which is expression of an extended-spectrum cephalosporinase, such as an AmpC-type enzyme or an ESBL, combined with porin loss. These isolates will also grow on the MacConkey agar and be identified as carbapenem-intermediate or resistant by standard susceptibility testing but these isolates are negative by the MHT. For isolates that test intermediate or resistant to carbapenems, it may not be necessary to distinguish between these mechanisms of resistance because all carbapenem-nonsusceptible Enterobacteriaceae produce a broad-spectrum β-lactamase, and are therefore an infection control concern. Implementing Contact Precautions for patients colonized with these bacteria would be appropriate. Laboratories may choose to test carbapenem-intermediate or resistant isolates with the MHT to identify carbapenemase-production for epidemiological purposes.

Procedure notes

1. The procedure described by Landman et al. (4) describes using a 10-µg imipenem disk for step 1. However, there are species of Enterobacteriaceae which have intrinsic mechanisms of resistance to imipenem other than a carbapenemase (See CLSI document M100, Appendix G)(2). Therefore, ertapenem or meropenem may provide more specific selection for acquired carbapenem resistance in Enterobacteriaceae.

2. Some laboratories performing cultures for isolation of CRE from rectal specimens place a 10-µg carbapenem disk in the first quadrant of the MacConkey plate. Only colonies growing "close" to the carbapenem disk are picked for characterization. No clear criteria for "close" have been established. However, it may be helpful to use either a meropenem or ertapenem disk and then apply the CLSI disk diffusion screening criteria to identify potential carbapenemase-producing isolates (i.e., an ertapenem or meropenem disk zone ≤ 21 mm). Note: These zone size criteria

were validated for standardized disk diffusion testing methods as described in CLSI document M2.

3. Carbapenemases are known to exist in several different species of gram-negative bacilli including species of Enterobacteriaceae and *Pseudomonas aeruginosa*. However, carbapenemases are more common in lactose-fermenting species of Enterobacteriaceae (e.g., *K. pneumoniae* and *E. coli*) than in non-lactose fermenting Enterobacteriaceae (e.g. *Serratia marcescens* and some *Enterobacter* spp.) and *P. aeruginosa*. In this procedure, it is suggested that laboratories focus their efforts on detection of resistant lactose-fermenting bacteria to reduce workload. Healthcare facilities that have identified clinical infections with carbapenemase-producing non-lactose fermenting gram-negative species should consider altering this procedure to include characterization of colonies with a morphology that is consistent with those species.

4. The exact procedure for confirmation of CRE or carbapenemase-production should be laboratory-specific and chosen based upon laboratory workflow and the types of isolates causing clinical infections in the patient population served. It may be helpful to refer to the CLSI guidelines for identification of carbapenemase production in isolates that test susceptible to carbapenems in document M100 (2).

5. A 1 x 10^4 CFU/mL suspension of the known carbapenem-resistant or carbapenem-susceptible isolates could be prepared as follows: Dilute 0.1 mL of a 0.5 McFarland standard suspension (equals approximately 1 x 10^8 CFU/ mL), in 9.9 mL sterile water or saline for a 1:100 dilution. From the 1:100, dilute 1.0 mL in 9.0 mL water or saline for a 1:1000 dilution. Add 0.5 mL of the 1:1000 dilution (equals approximately 1 x 10^5 CFU/mL), suspension to the 5 ml TSB for a final concentration of approximately 1 x 10^4 CFU/mL.

References

1. **Calfee, D., and S. G. Jenkins.** 2008. Use of active surveillance cultures to detect asymptomatic colonization with carbapenem-resistant *Klebsiella pneumoniae* in intensive care unit patients. Infect. Control Hosp. Epidemiol. **29:**966-8.

2. **Clinical and Laboratory Standards Institute/NCCLS.** 2009. *Performance Standards for Antimicrobial Susceptibility Testing.* Nineteenth informational supplement. M100-S19. CLSI, Wayne, PA.

3. **Deshpande, L. M., R. N. Jones, T. R. Fritsche, and H. S. Sader.** 2006. Occurrence and characterization of carbapenemase-producing Enterobacteriaceae: report from the SENTRY Antimicrobial Surveillance Program (2000-2004). Microb. Drug Resist. **12:**223-230.

4. **Landman, D., J. K. Salvani, S. Bratu, and J. Quale.** 2005. Evaluation of techniques for detection of carbapenem-resistant *Klebsiella pneumoniae* in stool surveillance cultures. J. Clin. Microbiol. **43:**5639-5641.

5. **Siegel, J. D., E. Rhinehart, M. Jackson, L. Chiarello, and HICPAC.** 2007. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings 2007. www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf

6. **Siegel, J. D., E. Rhinehart, M. Jackson, L. Chiarello, and HICPAC.** 2006. Management of Multidrug-Resistant Organisms in Healthcare Settings 2006. www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf

CRE Rectal Screening: Specimen Collection Protocol

Background:

Following isolation of a carbapenemase-producing *Enterobacteriaceae* (CRE), screening cultures may be recommended in consultation with Oregon Health Authority (OHA). Other appendices provide additional information for informing staff and patients as well as specimen processing.

Steps to Prepare for Specimen Collection:

(1) Work with administration and Infection Prevention & Control to clarify costs and payment of surveillance cultures.

(2) Collaborate with the laboratory and OHA regarding supplies:

   (a) OHA recommends culture swabs prepackaged in neutralizing buffer (e.g., liquid Stuarts or phosphate buffered saline).

(3) Inform and educate staff about CRE. Train staff on specimen collection.

(4) Inform and educate patients regarding CRE and the reason for screening cultures. Obtain written patient consent if needed.

(5) Collaborate with the laboratory regarding:

   (a) Timing of collection for optimal delivery and set-up (e.g., specimen collection on either Monday or Tuesday is typically preferred).

   (b) Appropriate test order entry (e.g., screening or surveillance test).

(6) Collaborate with the laboratory and Infection Prevention & Control to manage test results.

   (a) Include pertinent clinician groups (e.g., Infectious Diseases, Critical Care, Pharmacy, etc).

   (b) Determine manner of reporting in the patient's chart or "flagging" of positive results.

Specimen Collection Protocol:

This protocol is written using culture swabs for rectal, perirectal or stool culture sites, but it is applicable to premoistened "sponge sticks" and other clinical sites, as well. If multiple sites are cultured, use one swab per site to prevent cross-contamination.

(1) In consultation with OHA, identify high-risk contacts to undergo surveillance cultures.

(2) Premoisten the sterile swab in liquid transport media in the accompanying culturette tube.

(3) Insert moistened tip of swab into the anal canal and turn 2-3 times.

    (a) Alternatively, sample stool for culture if visible on the perianal skin or in an ostomy bag.

(4) Replace swab in culturette tube and secure top.

(5) Label specimen with at least **2** patient identifiers, date, site and collector's initials. Place in sealed specimen bag.

(6) Make sure to note type of culture as "screening."

(7) Send specimen to the laboratory; again, ensure laboratory is aware of correct methodology to process specimen.

    (a) Note: specimens should be plated ideally within 4 hours of collection. If significant delay on plating specimens occurs, store swabs at 4° Celsius for up to 3 days.

References:

CDC. Guidance for Control of Carbapenem-resistant *Enterobacteriaceae* (CRE). 2012.

APIC. Guide to the Elimination of Multidrug-resistant *Acinetobacter baumannii* Transmission in Healthcare Settings. 2010.

Prabaker K et al. Transfer from High-acuity long-term care facilities is associated with carriage of *Klebsiella pneumoniae* carbapenemase-producing *Enterobacteriaceae*: A multihospital study. ICHE 2012;33:1193–1198.

Oregon CRE Definition

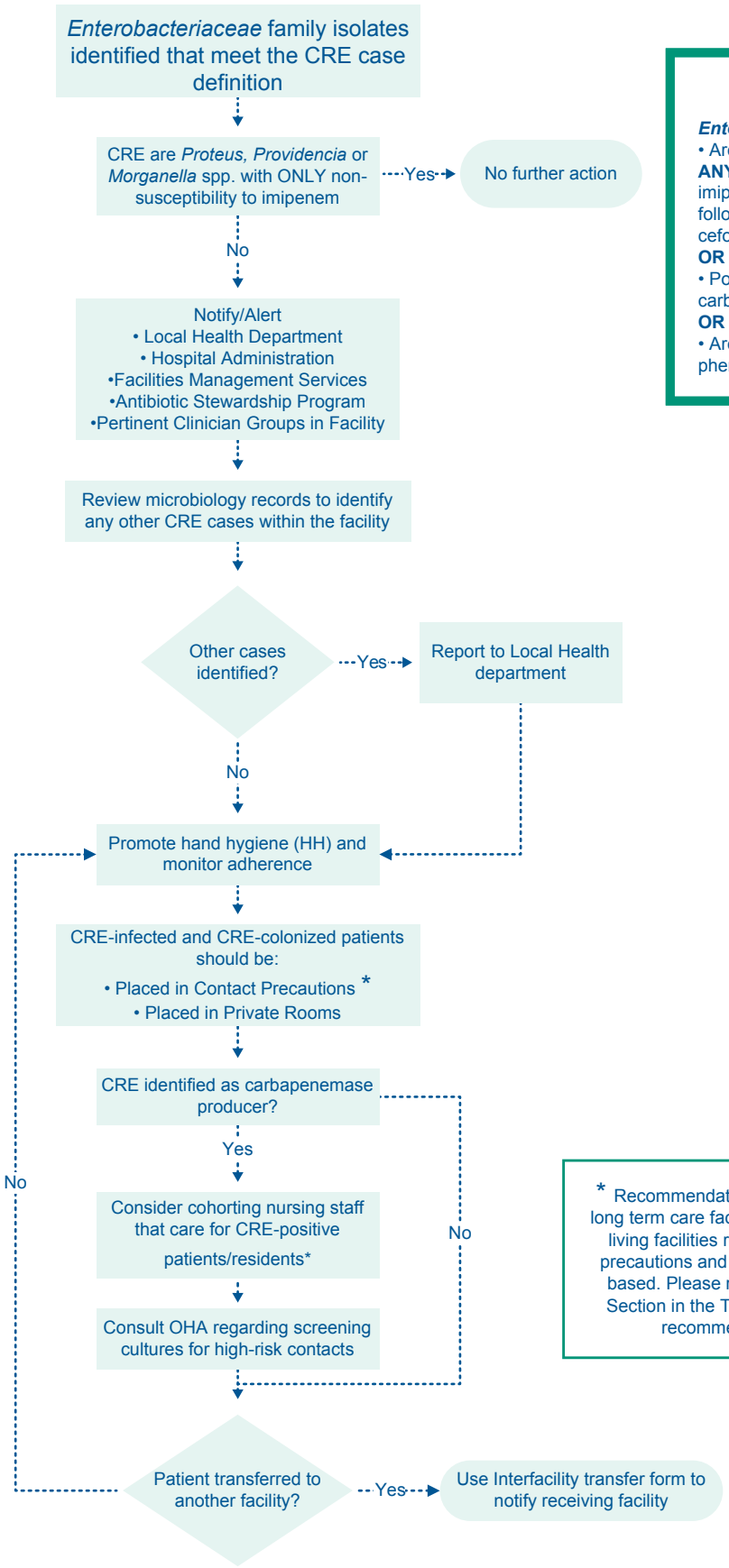
Carbapenem-resistant *Enterobacteriaceae…*
Are non-susceptible (i.e., intermediate or resistant) to ANY carbapenem (e.g., doripenem, ertapenem, imipenem, or meropenem) AND resistant to ANY of the following 3rd generation cephalosporins tested: cefotaxime, ceftriaxone, or ceftazidime
—OR—
Possess/contain a gene sequence specific for carbapenemase (PCR)
—OR—
Are positive for carbapenemase production by a phenotypic test (e.g., Modified Hodge Test)

CRE Assesment Tiers

Tier	Description	Organisms Included	Recommended Action
1	**Carbapenemase-producing CRE (CP-CRE)**	•Contain a gene sequence specific for carbapenemase (KPC, NDM etc.) •MHT positive *Enterobacteriaceae* EXCEPT *Enterobacter* spp.	Most aggressive control measures; see OR CRE Toolkit
2	**CRE with acquired resistance NOT due to carbapenemase production**	•CRE that do not qualify as either Tier 1 or Tier 3† •Includes MHT positive, PCR negative *Enterobacter* spp.	Intensified control measures including contact precautions
3	**CRE with intrinsic (natural) imipenem resistance**	*Proteus, Providencia and Morganella* spp. with ONLY imipenem non-susceptibility	No special control measures needed

CRE = Carbapenem-resistant *Enterobacteriaceae;* MHT = Modified Hodge Test; PCR = polymerase chain reaction for carbapenemase gene; †If not already done, perform MHT and PCR carbapenemase testing.

CRE Response Diagram for Infection Control



Oregon CRE case definition

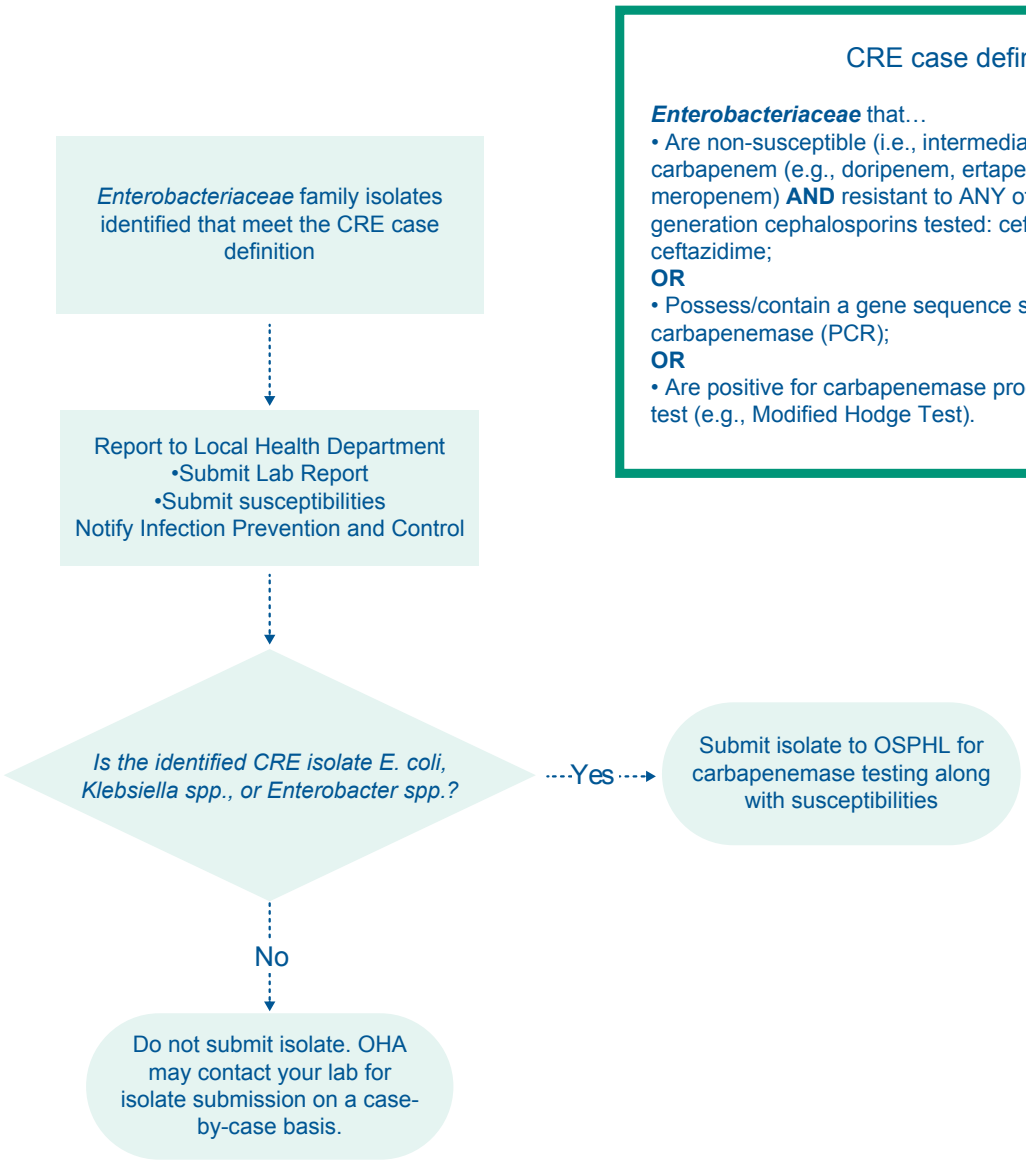
Enterobacteriaceae that…
• Are non-susceptible (i.e., intermediate or resistant) to **ANY** carbapenem (e.g., doripenem, ertapenem, imipenem, meropenem) **AND** resistant to ANY of the following 3rd generation cephalosporins tested: cefotaxime, ceftriaxone, or ceftazidime;
OR
• Possess/contain a gene sequence specific for carbapenemase (PCR);
OR
• Are positive for carbapenemase production by a phenotypic test (e.g., Modified Hodge Test).

* Recommendations for non-acute long term care facilities and assisted living facilities regarding contact precautions and cohorting are risk based. Please refer to the LTCF Section in the Toolkit for specific recommendations.

4/4/13

Oregon Health Authority

CRE Response Diagram for Laboratories



CDC Environmental Checklist for Monitoring Terminal Cleaning[1]

Date:	
Unit:	
Room Number:	
Initials of ES staff (optional):[2]	

Evaluate the following priority sites for each patient room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
Bed rails / controls			
Tray table			
IV pole (grab area)			
Call box / button			
Telephone			
Bedside table handle			
Chair			
Room sink			
Room light switch			
Room inner door knob			
Bathroom inner door knob / plate			
Bathroom light switch			
Bathroom handrails by toilet			
Bathroom sink			
Toilet seat			
Toilet flush handle			
Toilet bedpan cleaner			

Evaluate the following additional sites if these equipment are present in the room:

High-touch Room Surfaces[3]	Cleaned	Not Cleaned	Not Present in Room
IV pump control			
Multi-module monitor controls			
Multi-module monitor touch screen			
Multi-module monitor cables			
Ventilator control panel			

Mark the monitoring method used:

☐ Direct observation ☐ Fluorescent gel
☐ Swab cultures ☐ ATP system ☐ Agar slide cultures

---

[1]Selection of detergents and disinfectants should be according to institutional policies and procedures
[2]Hospitals may choose to include identifiers of individual environmental services staff for feedback purposes.
[3]Sites most frequently contaminated and touched by patients and/or healthcare workers

Insert Date

Dear Staff,

As part of a recommendation from the Name of Facility Infection Prevention and Controls' ongoing efforts to improve patient safety, your unit will be participating in a screening culture survey to assess the presence of the carbapenem resistant Enterobacteriaciae (CRE).

A process has been put in place to minimize the impact that this survey will have on your unit. We hope to complete the survey during Number of days .

All patients in the following groups are recommended to receive rectal screening cultures adapt criteria for facility .

The risk of surveillance cultures is considered minimal, and there will be no additional cost to the patients. Patients may request to know their results.

Please direct further questions to your supervisor.

signed by IP at the facility

Hospital/Facility Letterhead

Date

Dear Patient,

As part of insert your facility Infection Prevention and Control Program's ongoing efforts to improve patient safety, your health care provider would like to take a swab culture ("screening survey") to look for a certain gram-negative bacteria called carbapenem resistant Enterobacteriaciae (CRE). Further information about CRE is available from your healthcare provider.

This survey has been recommended by the Centers for Disease Control and Prevention (CDC) and the Oregon Public Health Division; insert your facility is voluntarily participating.

This survey will be of no additional cost to you, and will not interfere with your usual care. One swab will be obtained from the rectum or peri-rectal area. There is no risk to you.

The Infection Prevention and Control Program works to reduce the risk of infection to patients and staff within insert your facility . This is a useful way of assessing whether this organism is present and needs further action.

Thank you for your participation.

Should you have any questions, please ask your health care provider.

.....

Use bottom half only IF written consent is deemed necessary by your facility:

By signing below, I consent to collection of the cultures as described above.

Refusal to participate in this survey will not adversely affect your ability to receive health care services.

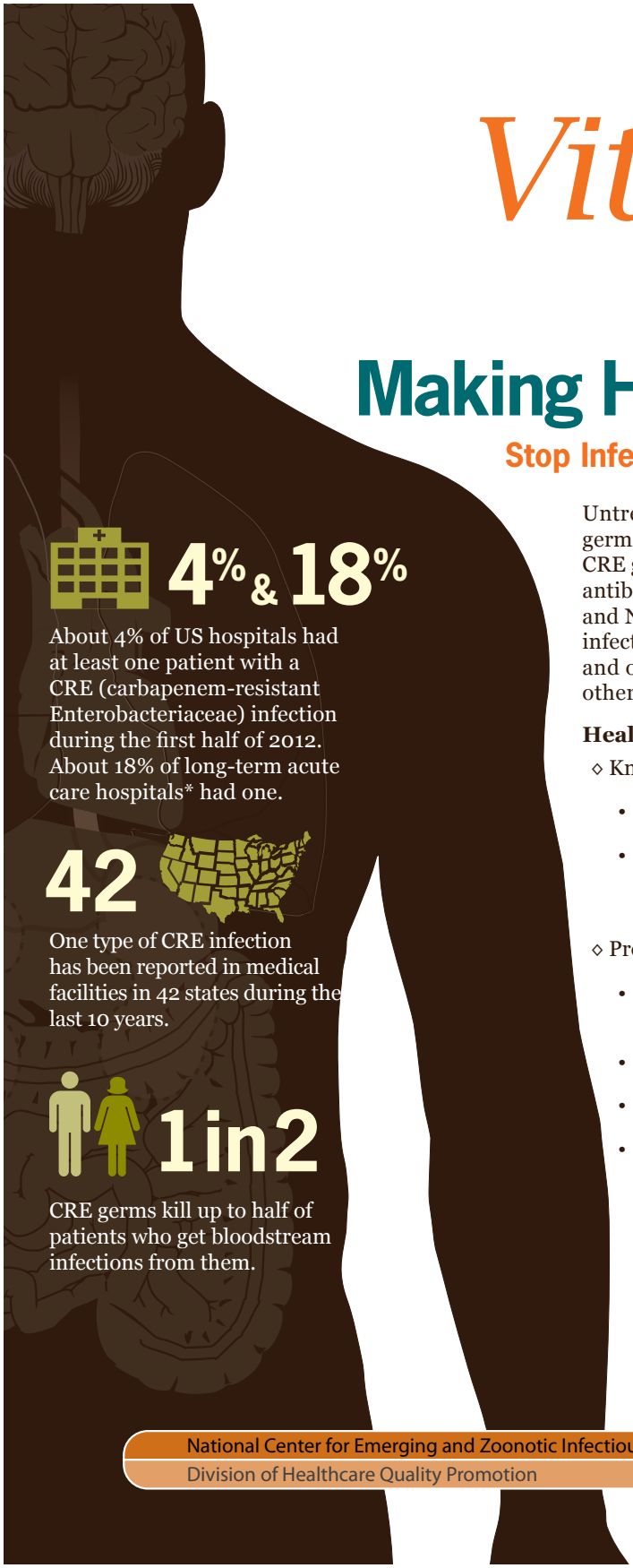
....

Date Signature

CDC Vitalsigns™
March 2013

Making Health Care Safer

Stop Infections from Lethal CRE Germs Now



4% & 18%

About 4% of US hospitals had at least one patient with a CRE (carbapenem-resistant Enterobacteriaceae) infection during the first half of 2012. About 18% of long-term acute care hospitals* had one.

42

One type of CRE infection has been reported in medical facilities in 42 states during the last 10 years.

1 in 2

CRE germs kill up to half of patients who get bloodstream infections from them.

Untreatable and hard-to-treat infections from CRE germs are on the rise among patients in medical facilities. CRE germs have become resistant to all or nearly all the antibiotics we have today. Types of CRE include KPC and NDM. By following CDC guidelines, we can halt CRE infections before they become widespread in hospitals and other medical facilities and potentially spread to otherwise healthy people outside of medical facilities.

Health Care Providers can

◇ Know if patients in your facility have CRE.

- Request immediate alerts when the lab identifies CRE.
- Alert the receiving facility when a patient with CRE transfers, and find out when a patient with CRE transfers into your facility.

◇ Protect your patients from CRE.

- Follow contact precautions and hand hygiene recommendations when treating patients with CRE.
- Dedicate rooms, staff, and equipment to patients with CRE.
- Prescribe antibiotics wisely.
- Remove temporary medical devices such as catheters and ventilators from patients as soon as possible.

*Long-term acute care hospitals provide complex medical care, such as ventilation or wound care, for long periods of time.

→ See page 4

Want to learn more? Visit

www http://www.cdc.gov/vitalsigns

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

Action is needed now to stop these deadly infections.

Problem

CRE germs have found ways to beat antibiotics.

- CRE infections are caused by a family of germs that are a normal part of a person's healthy digestive system. These germs can cause infections when they get into the bladder, blood, or other areas where germs don't belong.
- Some of these germs have become resistant to all or almost all antibiotics, including last-resort drugs called carbapenems. These resistant germs are called CRE.
- Almost all CRE infections happen to patients receiving serious medical care. CRE infections are hard to treat, and in some cases, untreatable. CRE kill up to half of patients who get bloodstream infections from them.
- In addition to spreading among people, CRE easily spread their antibiotic resistance to other kinds of germs, making those potentially untreatable as well.

CRE infections are spreading, and urgent action is needed to stop them.

- Although CRE germs are not very common, they have increased from 1% to 4% in the past decade. One type of CRE has increased from 2% to 10%.
- CRE are more common in some US regions, such as the Northeast, but 42 states report having had at least one patient test positive for one type of CRE.
- About 18% of long-term acute care hospitals and about 4% of short-stay hospitals in the US had at least one CRE infection during the first half of 2012.
- CRE's ability to spread themselves and their resistance raises the concern that potentially untreatable infections could appear in otherwise healthy people.

CRE infections can be prevented.

- Medical facilities in several states have reduced CRE infection rates by following CDC's prevention guidelines (see box).
- Israel decreased CRE infection rates in all 27 of its hospitals by more than 70% in one year with a coordinated prevention program.
- The US is at a critical time in which CRE infections could be controlled if addressed in a rapid, coordinated, and consistent effort by doctors, nurses, lab staff, medical facility leadership, health departments/states, policy makers, and the federal government.

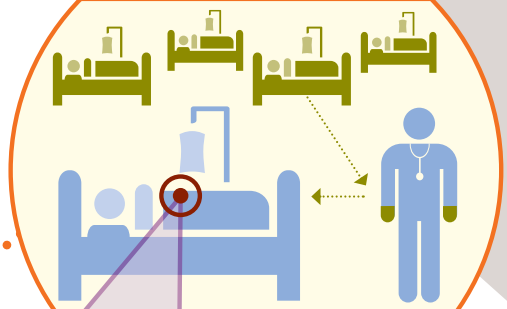
CDC's 2012 CRE Toolkit provides CRE prevention guidelines for doctors and nurses, hospitals, long-term acute care hospitals, nursing homes, and health departments. It gives step-by-step instructions for facilities treating patients with CRE infections and for those not yet affected by them. (http://www.cdc.gov/hai/organisms/cre/cre-toolkit/index.html)

Risk of CRE Infections

1. Local Short-Stay Hospital

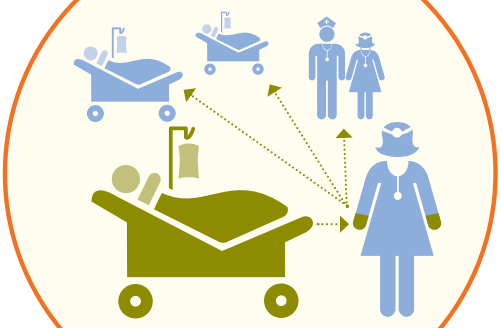
Jan has a stroke and is in the hospital. She is stable but needs long-term critical care at another facility.

2. Long-Term Acute Care Hospital



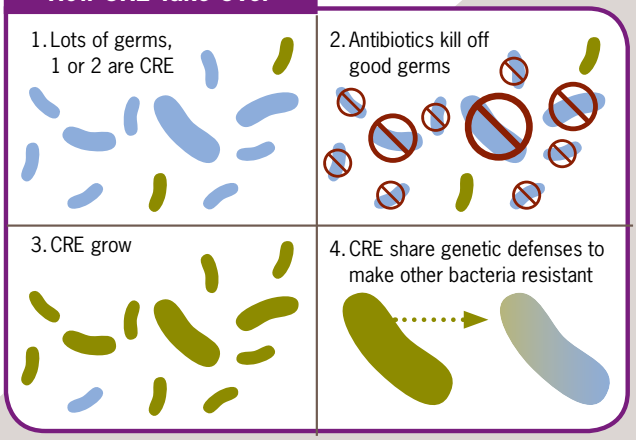
Other patients in this facility have CRE. A nurse doesn't wash his hands, and CRE are spread to Jan. She develops a fever and is put on antibiotics without proper testing.

3. Local Short-Stay Hospital



Jan becomes unstable and goes back to the hospital, but her new doctors don't know she has CRE. A doctor doesn't wash her hands after treating Jan. CRE are spread to other patients.

How CRE Take Over



SOURCE: CDC Vital Signs, 2013

Colorado Department of Public Health and Environment

- Colorado requires laboratories to report CRE and actively tracks the germs' presence.
- CDC, Colorado, and several facilities implemented CDC recommendations to control an outbreak of CRE.

Result: The outbreak was stopped.

Florida Department of Health

- CDC worked with Florida to stop a year-long CRE outbreak in a long-term acute care hospital.
- Improved use of CDC recommendations such as educating staff; dedicating staff, rooms, and equipment to patients with CRE; and improving use of gloves and gowns.
- **Result:** The percentage of patients who got CRE at the facility dropped from 44% to **0**.

3

What Can Be Done

Federal Government is

- Monitoring the presence of and risk factors for CRE infections through the National Healthcare Safety Network (NHSN) and Emerging Infections Program (EIP).
- Providing CRE outbreak support such as staff expertise, prevention guidelines, tools, and lab testing to states and facilities.
- Developing detection methods and prevention programs to control CRE. CDC's "Detect and Protect" effort supports regional CRE programs.
- Helping medical facilities improve antibiotic prescribing practices.

States and Communities can

- Know CRE trends in your region.
- Coordinate regional CRE tracking and control efforts in areas with CRE. Areas not yet or rarely affected by CRE infections can be proactive in CRE prevention efforts.
- Require facilities to alert each other when transferring patients with any infection.
- Consider including CRE infections on your state's Notifiable Diseases list.

Health Care CEOs/Medical Officers can

- Require and strictly enforce CDC guidance for CRE detection, prevention, tracking, and reporting.
- Make sure your lab can accurately identify CRE and alert clinical and infection prevention staff when these germs are present.
- Know CRE trends in your facility and in the facilities around you.
- When transferring a patient, require staff to notify the other facility about infections, including CRE.
- Join or start regional CRE prevention efforts, and promote wise antibiotic use.

Health Care Providers can

- Know if patients with CRE are hospitalized at your facility, and stay aware of CRE infection rates. Ask if your patients have received medical care somewhere else, including another country.
- Follow infection control recommendations with every patient, using contact precautions for patients with CRE. Whenever possible, dedicate rooms, equipment, and staff to CRE patients.
- Prescribe antibiotics wisely (http://www.cdc.gov/getsmart/healthcare). Use culture results to modify prescriptions if needed.
- Remove temporary medical devices as soon as possible.

Patients can

- Tell your doctor if you have been hospitalized in another facility or country.
- Take antibiotics only as prescribed.
- Insist that everyone wash their hands before touching you.

www http://www.cdc.gov/vitalsigns

For more information, please contact
Telephone: 1-800-CDC-INFO (232-4636)
***TTY*: 1-888-232-6348**
E-mail: cdcinfo@cdc.gov
Web: www.cdc.gov
Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
Publication date: 3/5/2013

CS238189B

CARBAPENEM-RESISTANT ENTEROBACTERIACEAE (CRE) –

Basic FAQs

What are CRE?

- Enterobacteriaceae are a large family of organisms mostly found in the gut. Commonly encountered Enterobacteriaceae are E. coli, Klebsiella species, and Enterobacter species.
- Carbapenems are an antibiotic class that includes doripenem, ertapenem, imipenem, and meropenem. Carbapenems are some of the strongest antibiotics and are often used for treating severe healthcare-associated infections.
- CRE are Enterobacteriaceae that are resistant to carbapenem antibiotics. Typically, they also are resistant to most other antibiotics. CRE can cause many types of infections including urinary tract infections, abdominal infections, pneumonia, and bloodstream infections.

Who gets CRE?

- CRE infections generally occur in hospitalized patients or residents of long-term care facilities. People at highest risk for CRE infections are those who have compromised immune systems and devices like tubes or drains going into their body. People taking antibiotics may be more likely to get CRE infections.

Can CRE be treated?

- Yes, generally. The antibiotics that will work against CRE are limited but some options are usually available.
- Persons who are CRE carriers (i.e., colonized with CRE) do not need antibiotics.

How can the spread of CRE be prevented?

- HAND WASHING: Expect all doctors, nurses, and other healthcare providers wash their hands; if they do not, ask them to do so. Also, clean your own hands often, especially after using the bathroom and before preparing or eating food.
- If you have been diagnosed with CRE in the hospital, you will be placed in “contact precautions” to prevent spread to others. This means that all hospital staff and all visitors should wear gowns and gloves when they enter your room.

Oregon Health Authority

CARBAPENEM-RESISTANT ENTEROBACTERIACEAE (CRE):

Detailed Patient FAQs

What are CRE?

CRE, which stands for Carbapenem-resistant Enterobacteriaceae, are a family of germs that are difficult to treat because they have high levels of resistance to antibiotics. CRE are an important emerging threat to public health.

Common Enterobacteriaceae include Klebsiella species and Escherichia coli (E. coli). These germs are found in normal human intestines (gut). Sometimes these bacteria can spread outside the gut and cause serious infections, such as urinary tract infections, bloodstream infections, wound infections, and pneumonia. Enterobacteriaceae can cause infections in people in both healthcare and community settings.

Carbapenems are a group of antibiotics that are usually reserved to treat serious infections, particularly when these infections are caused by germs that are highly resistant to antibiotics. Sometimes carbapenems are considered antibiotics of last resort for some infections. Some Enterobacteriaceae can no longer be treated with carbapenems because they have developed resistance to these antibiotics (i.e., CRE); resistance makes the antibiotics ineffective in killing the resistant germ. Resistance to carbapenems can be due to a few different mechanisms. One of the more common ways that Enterobacteriaceae become resistant to carbapenems is due to production of Klebsiella pneumoniae carbapenemase (KPC). KPC is an enzyme that is produced by some CRE that was first identified in the United States around 2001. KPC breaks down carbapenems making them ineffective. Other enzymes, in addition to KPC, can breakdown carbapenems and lead to the development of CRE, but they are uncommon in the United States.

How are CRE spread?

To get a CRE infection, a person must be exposed to CRE germs. CRE germs are usually spread person to person through contact with infected or colonized people, particularly contact with wounds or stool. CRE can cause infections when they enter the body, often through medical devices like ventilators, intravenous catheters, urinary catheters, or wounds caused by injury or surgery.

Who is most likely to get an infection with CRE?

CRE primarily affect patients in acute and long-term healthcare settings, who are being treated for another condition. CRE are more likely to affect those patients who have compromised immune systems or have invasive devices like tubes going into their body. Use of certain types of antibiotics might also make it more likely for patients to get CRE. Healthy people usually don’t get CRE infections.

Can CRE be treated?

Many people with CRE will have the germ in or on their body without it producing an infection. These people are said to be colonized with CRE, and they do not need antibiotics for the CRE. If the CRE are causing an infection, the antibiotics that will work against it are limited but some options are often available. In addition, some infections might be able to be treated with other therapies, like draining the infection. Strains that have been resistant to all antibiotics are very rare but have been reported.

What are some things hospitals are doing to prevent CRE infections?

To prevent the spread of CRE, healthcare personnel and facilities can follow infection-control precautions provided by CDC. These include:

- Washing hands with soap and water or an alcohol-based hand sanitizer before and after caring for a patient
- Carefully cleaning and disinfecting rooms and medical equipment
- Wearing gloves and a gown before entering the room of a CRE patient
- Keeping patients with CRE infections in a single room or sharing a room with someone else who has a CRE infection
- Whenever possible, dedicating equipment and staff to CRE patients
- Removing gloves and gown and washing hands before leaving the room of a CRE patient
- Only prescribing antibiotics when necessary
- Removing temporary medical devices as soon as possible
- Sometimes, hospitals will test patients for these bacteria to identify them early to help prevent them from being passed on to other patients

What can patients do to prevent CRE infections?

Patients should:

- Tell your doctor if you have been hospitalized in another facility or country.
- Take antibiotics only as prescribed.
- Expect all doctors, nurses, and other healthcare providers wash their hands with soap and water or an alcohol-based hand rub before and after touching your body or tubes going into your body. If they do not, ask them to do so.
- Clean your own hands often, especially:
    - o Before preparing or eating food
    - o Before and after changing wound dressings or bandages
    - o After using the bathroom
    - o After blowing your nose, coughing, or sneezing
- Ask questions. Understand what is being done to you, the risks and benefits.

What if I have CRE?

Follow your healthcare provider's instructions. If your provider prescribes you antibiotics, take them exactly as instructed and finish the full course, even if you feel better. Wash your hands, especially after you have contact with the infected area and after using the bathroom. Follow any other hygiene advice your provider gives you.

I am caring for someone with CRE at home; do I need to take special precautions?

CRE have primarily been a problem among people with underlying medical problems, especially those with medical devices like urinary catheters or those with chronic wounds. Otherwise healthy people are probably at relatively low risk for problems with CRE. People providing care at home for patients with CRE should be careful about washing their hands, especially after contact with wounds or helping the CRE patient to use the bathroom or after cleaning up stool. Caregivers should also make sure to wash their hands before and after handling the patient's medical device (e.g., urinary catheters). This is particularly important if the caregiver is caring for more than one ill person at home. In addition, gloves should be used when anticipating contact with body fluids or blood.

Is CRE infection related to medical care abroad?

A variety of enzymes produced by Enterobacteriaceae make them resistant to carbapenems. Several of these enzymes appear to be more common in other countries than they are in the United States. In the United States, patients infected or colonized with CRE have been identified from patients that received care in Greece, India, Italy, Pakistan, or Vietnam. None of these patients had gone to these countries specifically for a medical procedure (medical tourism), however, as with medical care in the United States, medical care abroad can be associated with healthcare–associated infections and/or resistant bacteria.

For More Information:

Oregon Health Authority Resources:
http://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/Pages/disease.aspx?did=108

Centers for Disease Control and Prevention (CDC) Resources:
http://www.cdc.gov/HAI/organisms/cre/index.html
http://www.cdc.gov/vitalsigns/hai/cre/

These FAQ's were accessed directly from CDC's website April 4, 2013.

Patient Safety:

Ten Things You Can Do to Be a Safe Patient

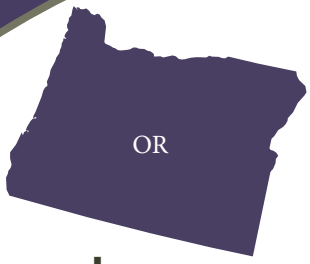
What can you do as a patient or loved one of a patient?
Be informed. Be empowered. Be prepared.

Here are 10 ways to be a safe patient:

1. **Speak up.**
   Talk to your doctor about any worries you have about your safety and ask them what they are doing to protect you.
2. **Keep hands clean.**
   If you do not see your providers clean their hands, please ask them to do so. Also remind your loved ones and visitors. Washing hands can prevent the spread of germs.
3. Ask if you still need a **central line catheter or urinary catheter**.
   Leaving a catheter in place too long increases the chances of getting an infection.
4. **Ask your healthcare provider,** "will there be a new needle, new syringe, and a new vial for this procedure or injection?" Healthcare providers should never reuse a needle or syringe on more than one patient.
5. **Be careful with medications.**
   Avoid taking too much medicine by following package directions. Also, to avoid harmful drug interactions, tell your doctor about all the medicines you are taking.
6. **Get Smart about antibiotics.**
   Help prevent antibiotic resistance by taking all your antibiotics as prescribed, and not sharing your antibiotics with other people. Remember that antibiotics don't work against viruses like the ones that cause the common cold.
7. **Prepare for surgery.**
   There are things you can do to reduce your risk of getting a surgical site infection. Talk to your doctor to learn what you should do to prepare for surgery. Let your doctor know about other medical problems you have.
8. **Watch out for C. diff (aka *Clostridium difficile*).**
   Tell your doctor if you have severe diarrhea, especially if you are also taking an antibiotic.
9. **Know the signs and symptoms of infection.**
   Some skin infections, like MRSA, appear as redness, pain, or drainage at an IV catheter site or surgical incision site, and a fever. Tell your doctor if you have these symptoms.
10. **Get your flu shot.**
    Protect yourself against the flu and other complications by getting vaccinated.

References: http://www.cdc.gov/HAI/patientSafety/patient-safety.html

Public Health Practice Stories from the Field



Oregon Creates a Statewide Network to Limit the Spread of Carbapenem-Resistant Enterobacteriaceae

Surveyed
hospitals, laboratories, and long-term care facilities and found a need for a unified approach to controlling multidrug-resistant organisms

Established
a statewide network of hospitals, laboratories, and long-term care facilities to detect, prevent, and control CRE

Developed
a statewide database to track CRE control, along with educational materials and tools to help facilities identify and control CRE, complementing national CRE surveillance efforts

Initiated
discussions to expand the statewide network to other states on the West Coast and create a regional approach to CRE control

Carbapenem-resistant Enterobacteriaceae (CRE) are an emerging threat to public health. Enterobacteriaceae are a large family of bacteria mostly found in the gastrointestinal tract. Commonly encountered Enterobacteriaceae include *Escherichia coli*, *Klebsiella* spp., and *Enterobacter* spp. Enterobacteriaceae frequently cause urinary tract infections, abdominal infections, and healthcare-associated pneumonia.

Carbapenems are some of the strongest antibiotics and are often reserved for treating severe healthcare-associated infections. CRE are Enterobacteriaceae that are resistant to carbapenems. Typically, they also are resistant to most other antibiotics. During the last 10 years, 42 states have reported at least one patient testing positive for one type of CRE. CRE infections generally occur in hospitalized patients or residents of long-term care facilities. Though CRE is rare in Oregon, its presence is alarming because the bacteria can cause infections that are difficult or even impossible to treat. The death rate of patients with CRE bloodstream infections is extremely high (up to 50%).

A needs assessment survey of acute care hospitals, microbiology laboratories, and long-term care facilities in Oregon showed that

- A unified approach to prevention and control of multidrug-resistant organisms was lacking
- Oregon facilities were in need of clear CRE case definitions and would appreciate CRE education
- CRE laboratory detection and reporting were variable

OSTLTS
Office for State, Tribal, Local and Territorial Support

Centers for Disease Control and Prevention
Office for State, Tribal, Local and Territorial Support

What We Did

To create a cohesive, thoughtful, and reliable response to the emerging threat of CRE, we have created the Drug-Resistant Organism Prevention and Coordinated Regional Epidemiology (DROP-CRE) Network. The primary objective of the network is to establish statewide coordination of prevention and control of multidrug-resistant organisms, initially focusing on CRE. The DROP-CRE Network is spearheaded by the Oregon Health Authority in collaboration with epidemiologists from Oregon Health & Science University, Portland VA Medical Center, and Oregon State University. The network advisory committee consists of infectious disease physicians, microbiologists, infection control practitioners, and representatives of long-term care facilities.

Our DROP-CRE Network is

- Developing a statewide multidrug-resistant organism database
- Promoting CRE education statewide
- Conducting rapid regional identification of CRE
- Providing real-time epidemiologic outbreak assistance to Oregon facilities with CRE cases
- Tracking CRE statewide across the spectrum of care

We are also developing CRE case report forms, a toolkit for Oregon facilities with CRE cases, and forms to monitor transfer of CRE-infected patients. We are presenting at key meetings, conferences, and webinars and creating flyers, handouts, and a dedicated CRE web page to educate healthcare professionals across the state about the importance of preventing CRE.

What We Accomplished

We have already accomplished many of our initial goals in setting up the network and now are beginning to focus on active CRE response. We have

- Initiated tracking and investigating reported CRE in Oregon
- Advised on a CRE case in real time involving transfer of a patient with CRE from a long-term care facility to a hospital and back
- Coordinated an investigation of an outbreak of multidrug-resistant *Acinetobacter baumannii*

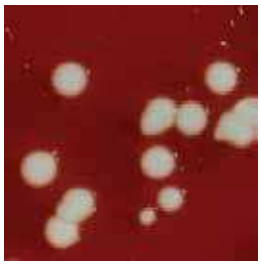
Additionally, we have initiated communication with other states for potential expansion of the network to encompass large-scale regional control of CRE focused on the US West Coast.

For more stories, visit
www.cdc.gov/stltpublichealth/phpracticestories

For information about this story, contact
Oregon Health Authority
Zintars Beldavs
Manager, Healthcare-Associated Infections Program
Telephone: 971-673-1111
Email: **zintars.g.beldavs@state.or.us**

For information about this product, contact
Centers for Disease Control and Prevention
1600 Clifton Road NE, Atlanta, GA 30333
OSTLTS Toll-free Helpdesk: 866-835-1861
Email: **OSTLTSfeedback@cdc.gov**
Web: **www.cdc.gov/stltpublichealth**

Publication date: 03/12/2013



CRE: Carbapenem-Resistant *Enterobacteriaceae*

The Facts:

- These bugs usually inhabit the digestive system and are resistant to our best antibiotics.
- **CRE** are found primarily in health care facilities.
- **CRE** typically cause infections in people with multiple health problems, especially those who have received antibiotics frequently and/or reside in long term care facilities.
- To date, Oregon has very few CRE (visit the Oregon Health Authority website for current case counts).
- The most serious type is carbapenemase-producing (CP) CRE
  - CP CRE contain ***an enzyme which inactivates carbapenem antibiotics directly (i.e., carbapenemase),*** and this resistance is more easily transmissible within and between bacterial species.
  - The most common carbapenemase in the U.S. is *Klebsiella pneumoniae* carbapenemase (KPC) because this enzyme was 1st discovered on a bacteria called *Klebsiella pneumoniae.* While *Klebsiella* spp. organisms are the most common KPC-producers, *E. coli* and other *Enterobacteriaceae* can also harbor KPC (and other carbapenemase) enzymes.
- **It is important to control all types of CRE**

What you need to do when providing care for the CRE patient:

- Perform meticulous hand hygiene using an alcohol-based hand gel or soap and water.
- Place patient in private room and make sure **Contact Precautions** are followed.
- To the extent possible, limit the number of people who provide care to the patient.
- Perform thorough cleaning and disinfection of environmental surfaces in the room.
- Be sure equipment is thoroughly cleaned and disinfected before removing it from the room.
- Call Infection Prevention and Control with any immediate questions or concerns.
- See the Centers for Disease Control and Prevention (CDC) and the Oregon Health Authority (OHA) website for further information: http://www.cdc.gov/HAI/organisms/cre/index.html; https://public.health.oregon.gov/DiseasesConditions/DiseasesAZ/Pages/disease.aspx?did=108.

We thank you for your diligence in keeping our patients and staff safe!

Think “NICE” when CRE are encountered:

Notify the county health department, pertinent clinician groups, and the antibiotic stewardship program to presence of CRE in the facility. Additionally, for carbapenemase-producing (CP-CRE), notify hospital administration.

Intervene on all cases with core infection prevention and control strategies: hand hygiene, contact precautions, private rooms, and optimized environmental cleaning. Reduce unnecessary antibiotics and use of invasive devices. Additionally, for CP-CRE, screen patient contacts and cohort staff and patients.

Communicate CRE infection or colonization status to the receiving facility upon patient transfer.

Educate patients, staff, and visitors about CRE.

Oregon Health Authority

CENTER FOR PUBLIC HEALTH PRACTICE
Acute and Communicable Disease Prevention Program

Phone: 971-673-1111
Fax: 971-673-1100
www.healthoregon.org/acd

OHA8589 (05.13)